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Minority Access to Research Careers:
An Evaluation of the Honors Undergraduate Research Training Program

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Minority Access to Research Careers: An Evaluation of the Honors Undergraduate Research Training Program

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Committee on National Needs for Biomedical and Behavioral Research Personnel

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SUMMARY

The Minority Access to Research Careers (MARC) program was created by the National Institute of General Medical Sciences (NIGMS) to increase the number of biomedical scientists from minority groups. The largest component of the MARC program is the Honors Undergraduate Research Training Program. Trainees (junior and senior level honors students at schools with enrollments drawn substantially from minority groups) receive tuition and stipend support and participate in a specially structured curriculum. Exposure to ongoing research in the biomedical sciences is a central component of the training experience.

The MARC Honors program has as its principal objective the encouragement of minority students in the pursuit of graduate training leading to the Ph.D. degree. It began in 1977 with 74 trainees at 12 participating schools. By 1984 there were 389 undergraduate trainees at 52 programs involving 56 undergraduate institutions. As of August 1984, there were nearly 800 program alumni.

At the request of NIGMS, the Committee on National Needs for Biomedical and Behavioral Research Personnel has undertaken an evaluation of the Honors Undergraduate Research Training Program. The study design, consisting of an analysis of existing data on the training of minority group scientists, site visits to ongoing training programs, and a survey of former trainees is described in Chapter 1.

The MARC Honors program was established in response to the small number of minority group members holding research doctorates in the biomedical sciences. Chapter 2 presents a brief statistical overview of the program. Examination of the most current data on scientific employment and training in Chapter 3 demonstrates that minority group members are still underrepresented at all stages of the scientific career. Although some reduction of the minority/nonminority disparity has taken place, substantial underrepresentation of minorities remains the rule.

Site visits to five MARC Honors training programs (described in Chapter 4) reveal a diverse array of program activities adapted to the needs of the recipient institutions and their students. The MARC Honors program (often working in conjunction with another NIH program, the Minority Biomedical Research Support Program) brings guest speakers to campus, develops new courses, purchases laboratory equipment, and fosters institutional connections between program schools and major research centers. Most of these activities benefit the entire scientific community on campus.

Individual trainees receive stipends and work closely with faculty members on laboratory research projects. As part of their training, they also attend scientific seminars, conferences, and meetings. A summer research project (usually at a major research university) is a significant part of the MARC Honors experience. Trainees report that the laboratory exposure and close contact with faculty members is an important part of their academic and professional development. Many credit these experiences with shaping their decision to pursue research careers.

Faculty members report high levels of motivation among the MARC Honors students and note several examples of published research by undergraduate trainees. At almost every institution the faculty members identified highly talented students who might not have been able to finish school without the availability of MARC stipends.

Two important issues emerged from the site visits. There seems to be some disagreement over the optimal location of the trainees' summer research experience. Some MARC faculty members feel that the student is best served by continuing a research project at the home institution. Others find the benefits of external placement (personal growth as well as broader research experience) to be significant. Emphasis on external placement varies within and across program institutions.

A second issue concerns the selection of trainees. The MARC Honors program was designed explicitly to prepare students for research careers, yet many talented undergraduate science majors plan to pursue professional (but not necessarily research) careers. The question of how to treat students with professional career plans is a crucial issue in the selection of MARC Honors applicants.

A questionnaire inquiring about educational and occupational status was sent to all MARC Honors program alumni. Sixty-five percent of the 821 former trainees in the study population returned the questionnaires. Survey results, presented in Chapter 5, show that 76.1 percent of the former trainees have enrolled in graduate or professional programs at some point. As of November 12, 1984 (the survey reference date), 43.5 percent of the former trainees were enrolled in doctorate programs (128 in M.D. or D.D.S. programs, 86 in Ph.D. programs and 3 in M.D./Ph.D. programs). Another 15.1 percent were enrolled in master's degree programs. Since the first MARC Honors cohort graduated in 1978 (and the first full, two-year trainee cohort in 1979), there has been limited time in which to complete work on a Ph.D. degree. By the fall of 1984, 22 people from the first 3 trainee cohorts (21.2 percent) had earned doctorate degrees. Of the completed doctorates, the vast majority were M.D.s; only one respondent had completed a Ph.D. at the time of the survey. Most of the former trainees who were no longer in school were employed in science or engineering fields (62.4 percent). The unemployment rate of former trainees was 9.2 percent and unemployment was concentrated among those without graduate degrees. While exact comparisons cannot be made, the rates of graduate school attendance and employment in science fields for the former MARC Honors trainees are above the levels found in the most closely comparable national data.

Overall, 35.7 percent of the respondents expected to be in research careers by the time they are 35 years old. Among those planning careers in the health professions, a smaller fraction (13.0 percent) expected to be doing research at age 35. Only a small fraction of the former trainees (7.4 percent) expect to be in jobs unrelated to science or engineering.

The survey did not reveal any serious deficiencies in the MARC Honors program. While some students left graduate or professional programs before receiving a degree (22.2 percent), nearly half are currently enrolled in another graduate or professional program. More

students withdrew from master's degree programs than from doctorate programs. Students reported a high level of satisfaction with the MARC Honors program in general and with the research component in particular.

Some evidence also points to an institutional impact of the MARC Honors program. National figures from Department of Education surveys (presented in Chapter 6) show that the percentage of students earning bachelor's degrees in biology has remained level since the late 1970s for minority students and has decreased for white students. At MARC schools, however, the percentage of biology majors increased (especially among minority students). Both the size and the length of the programs were associated with higher rates of degrees earned in biology. These effects persisted after the impact of other institutional characteristics were taken into consideration.

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1. INTRODUCTION

The Minority Access to Research Careers (MARC) Program of the National Institute of General Medical Sciences (NIGMS) is a program designed to increase the participation of members of minority groups in biomedical research. The MARC program has four major components:

1. Faculty Fellowship Program
2. Visiting Scientist Program
3. Honors Undergraduate Research Training Program
4. Predoctoral Training Program.

At the request of NIGMS, the committee has undertaken an evaluation of the Honors Undergraduate Research Training Program, the largest component of MARC. The evaluation focuses on a description of the scope of the program, the accomplishments of its initial graduates, and its impact on participating institutions.

The Honors Undergraduate Research Training Program provides tuition and stipends for third and fourth year honors students at institutions in which enrollments are drawn substantially from ethnic minority groups. The program has two objectives:

1. to increase the number of well-prepared minority students who can compete successfully for entry into graduate programs leading to the Ph.D. degree in a biomedical science, and

2. to help develop a strong science curriculum and research opportunities to prepare students for careers in biomedical research (U.S. Department of Health and Human Services, no date).

The first objective reflects the view that graduate education leading to the Ph.D. degree is the standard way to prepare for a career in biomedical research. It is recognized, however, that some trainees reach this goal via combined M.D./Ph.D. training programs or post-M.D. research training. Strengthening science curricula at the undergraduate level and providing opportunities to do research are considered means of achieving the first objective.

The Honors Undergraduate Research Training Program grants provide funds for trainee travel and research in addition to stipends and tuition. The training programs are expected to be multidepartmental in scope and to provide a formal research experience for the trainee (including a planned program of summer study and research). A detailed training plan is submitted by each applicant institution. Administrative support (including faculty salaries) is also provided.

The MARC Honors[1] program began in 1977 with 12 institutions and 74 trainees. By 1984 there were 52 training programs and 366 trainees. The growth and development of the Honors Undergraduate Research Training Program is outlined in detail in Chapter 2.

Minorities in the Biomedical Sciences

The MARC program was established in response to the underrepresentation of minorities in biomedical research. It is important that the efforts and accomplishments of the MARC program be viewed in that context. National data on the employment and education of minority and nonminority scientists are presented and discussed in Chapter 3.

MARC Honors Evaluation: Student Outcomes

The evaluation focuses on the two major program objectives:

- increasing enrollment in Ph.D. programs, and
- improving science curricula.

The primary source of data for the evaluation of student career outcomes is a survey of former MARC Honors program participants. No alternative body of data exists. (MARC Honors grant renewal applications contain some information on the career progress of program alumni, but this information is not collected in a standardized manner. NIH guidelines for grant applicants suggest that programs conduct "career surveys for graduates who continue their studies." Without a standardized survey methodology, the data obtained are neither complete nor comparable across institutions. A mailout questionnaire was sent to all MARC program alumni using addresses obtained from program directors, college alumni associations, and NIH records. The questionnaire instrument focused on three major areas (career plans, career attainments, and science education). The results of the survey of former trainees are presented in Chapter 5.

Within the general guidelines established by NIGMS, the MARC Honors programs reflect the unique designs of the individual grantees. The MARC Honors institutions differ from each other in academic traditions, educational missions, resources, and student populations. Program directors combine campus resources and program resources to meet the needs of their students. The programs vary in their training capacity, training activities, departmental composition, and faculty participation. Programs have been in operation for differing lengths of time, giving some program directors the opportunity to alter and

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[1]Throughout this report the term "MARC Honors" will refer to the MARC Honors Undergraduate Research Training Program.

adapt their training programs. These variations in institutional starting points and program resources cannot be expected to yield a uniform level of success; summary statistics on MARC Honors outcomes cannot reflect these differences in institutional and program characteristics. The standard methods for disentangling initial inputs, treatment levels, and program outcomes are handicapped by the small number of cases.

As a result of these constraints, certain types of insight are available only from a closer look at the operation of MARC programs. Case study data, collected in connection with the evaluation of curriculum development, provide this perspective.

MARC Evaluation: Institutional Outcomes

The second objective of the MARC Honors program is improved science curricula. This objective is far harder to evaluate than the entry of students into graduate study. Institutional change is more difficult to measure than student career achievements. Objective measures like the number of new courses may mask large scale quality differences. Comparisons are further complicated by the wide variation in institutional quality and curriculum development of schools when they enter the MARC Honors program.

Given these difficulties, an informative method of curriculum assessment is the examination, in detail, of a few selected MARC Honors programs. A case study approach adds a detailed, qualitative dimension to the evaluation. Efforts were concentrated on those schools with the longest MARC Honors experience. Schools of varying size and institutional development were selected for site visits. In order to obtain a broad view of problems and prospects confronting MARC programs, the site visits included representatives from four institutional categories:

- historically minority schools with an established tradition of research and graduate training in the biomedical sciences. These are Ph.D.- or M.D.-granting institutions (e.g., Howard University and Atlanta University);

- historically minority schools with less established traditions of biomedical research and graduate training. These schools are largely bachelor's degree-granting institutions (e.g., Tougaloo College, Talladega College, and Jackson State University);

- institutions with large Hispanic populations (e.g., University of New Mexico, University of Texas-San Antonio, and University of Puerto Rico-Rio Piedras); and

- urban institutions with substantial minority populations, but which are not historically minority schools (City College of New York, Hunter College, and California State University-Los Angeles).

Prior to the site visits, a review of the institution's MARC Honors grant application file was conducted to provide background on the operation of the program. The findings from the site visits are presented in Chapter 4.

A quantitative approach to the evaluation of curriculum enhancement will supplement the qualitative case study methodology. Using data from Department of Education surveys, an analysis of the proportion of students earning bachelor's degrees in the biological sciences was conducted to measure curriculum strength. The proportions of students earning bachelor's degrees in the biological sciences at MARC and nonMARC institutions (before and after the initiation of MARC Honors Undergraduate Research Training Programs) are examined and reported in Chapter 6.

2. A STATISTICAL OVERVIEW OF THE MARC HONORS UNDERGRADUATE RESEARCH TRAINING PROGRAM

The early years of the MARC Honors Undergraduate Research Training Program were characterized by an expansion of training sites and trainees. Program growth has slowed in recent years.

The first 12 Honors Undergraduate Research Training Program awards were made in 1977. Five new programs were added in each of the next two years. In 1980, the number of new awards rose to 13. In subsequent years, smaller numbers of new schools were added. In 1984, there were 52 MARC Honors programs in operation (Table 2.1). A list of program schools by year of first funding is presented in Appendix A.[1]

Funding for the Honors Undergraduate Research Training Program grew along with the number of programs supported (Table 2.1). In 1977, the budget was less than one million dollars. Small increments in 1978 and 1979 were followed by a major budget increase in 1980, the year that 13 new programs were added. The increase from 1.8 million dollars in 1979 to 3.3 million dollars in 1980 was the largest single increment in program funding. In fiscal year 1985, the projected budget for the Honors Undergraduate Research Training Program was 4.93 million dollars. Adjusting for inflation, the annual rate of growth in MARC Honors funding from 1977 through 1984 was 17.6 percent.

During the first fiscal year of operation (1977), there were 74 undergraduate trainees funded by the MARC Honors program. The number of trainees grew steadily over the next several years reaching 372 trainees in 1983. From 1977 to 1983, the annual growth rate was 30.9 percent. Since 1983, there has been little expansion in the number of trainees supported. Fewer trainees were supported in 1984 than in 1983, and the projected level for 1985 (389) is only slightly above the 1983 level.

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[1]Due to their limited period of operation, programs funded after 1982 are not included in this evaluation.

TABLE 2.1 Level of Funding for MARC Honors Undergraduate Research Training Programs ($ millions)

Fiscal Year	Funding		Number of Programs		Number of Trainees
	Current $	1972 $	New	Total	
1977	0.99	0.70	12	12	74
1978	1.29	0.85	5	17	117
1979	1.80	1.09	5	22	163
1980	3.27	1.83	13	35	237
1981	3.53	1.81	5	40	286
1982	4.20	2.03	4	42[b]	319
1983	4.65	2.16	8	49[c]	372
1984	4.88	2.18	3	52	366
1985 (projected)	4.93	[a]	1	53	389

[a]Adjustment factors are not available.
[b]Funding for two programs was not renewed.
[c]Funding for one program was not renewed.

SOURCE: National Institutes of Health, MARC Program Office.

At the present time, there are no administratively collected data on the race or ethnicity of MARC Honors Undergraduate trainees. Grants are made to institutions with "substantial minority populations," and the institutions themselves select the trainees from among their student applications. The list of institutions that have received grants is shown in Appendix A. An estimate of the racial/ethnic composition of the trainees supported under this program was obtained from a survey of former trainees conducted during this study and reported upon in Chapter 5.

Steady progress towards a bachelor's degree is the norm for MARC Honors trainees. Between 1978 and 1984, 677 trainees (86.2 percent) graduated while on the program. One hundred and eight trainees (13.8 percent) left the program prior to graduation. Many of these students graduated later. Some left the program because they exhausted their two years of MARC Honors funding; other terminations reflect changing educational and career plans. A few terminations were the result of an inability to maintain the required minimum 3.0 grade point average. The typical trainee spent 18.5 months in the MARC Honors program.[2]

[2]The median length of MARC funding is 19.9 months for trainees who graduate and 11.0 months for those who are terminated. These figures are based on the 576 cases with complete data (474 graduations and 102 terminations).

The majority of the MARC Honors Undergraduate trainees have been biology or biological science majors (Table 2.2). Nearly 60 percent earned their bachelor's degrees in biology or a related discipline (e.g., biochemistry, botany, or premed). Approximately one-fourth of the trainees were chemistry majors. The remaining 15 percent earned their degrees in psychology, physics, mathematical sciences, or other disciplines. The grade point average of the MARC Honors trainees (based on 448 cases with reported data) was 3.3.

TABLE 2.2 Distribution of MARC Trainees by Major Field

Field	Number	Percent
Biological Sciences	405	59.3
Chemistry	163	23.9
Psychology	46	6.7
Mathematics & Computer Sciences	41	6.0
Physics	16	2.3
Other	12	1.8
Total[a]	683	100.0

[a]Excludes cases with missing or unreported major field.

SOURCES: MARC Grant Renewal Applications and MARC Honors Survey.

3. MINORITY PARTICIPATION IN THE BIOMEDICAL SCIENCES

In recent years there has been some increase in the percentage of minority students earning degrees in the biological sciences. However, these small improvements in recent years have not dramatically altered the pattern of minority underrepresentation in scientific employment and training.

The Minority Access to Research Careers (MARC) Program was established in response to the underrepresentation of minority group members in the biomedical sciences. Over the past several years, there have been only modest changes in the percentage of scientists in the doctoral labor force from minority groups. The percentage of blacks among doctoral scientists increased slightly from 1973 to 1979 and again from 1979 to 1981 (Table 3.1). The size and the timing of the increase varied across academic disciplines. In very few cases was the shift steady and uninterrupted. Almost all fields increased their proportion of black doctoral scientists in the 1973 to 1979 period. In the life sciences, the percentage of blacks rose from 1.1 in 1973 to 1.3 in 1979 (an annual rate of growth of 2.8 percent). Only two fields--the social sciences and psychology--showed improvement for the 1979 to 1981 period.

The racial composition of the pool of employed scientists cannot change very rapidly since it is a cumulative distribution--each annual distribution is composed largely of members of the previous distributions. If changes are taking place, statistics on the education and training of new scientists would be most likely to show them.

Science Education

The underrepresentation of minorities in science is smallest at the earliest stages of training (Berryman, 1983). Using data from the 1970s, Astin (1982) found that black representation among biological science majors declined from college entry (6.9 percent) to baccalaureate completion (4.3 percent) to master's completion (3.4 percent) to doctorate completion (1.5 percent). Similar patterns were found for Puerto Ricans and Chicanos. The white percentage, however, rose at each step. Whites were 89.3 percent of the freshman biology majors, 90.4 percent of the biology baccalaureate recipients, and 93.3 percent of the biology doctorate recipients.

TABLE 3.1 Black Scientists with Research Doctorates as a Percentage of the Total Population of Scientists with Research Doctorates, 1973-81

	Year		
Field	1973	1979	1981
Total Science	1.0%	1.2%	1.4%
Physics	0.9%	0.8%	0.9%
Mathematics	0.8%	1.2%	1.2%
Computer Science	a	a	a
Environmental Science	a	0.7%	a
Life Science	1.1%	1.3%	1.3%
Psychology	1.1%	1.5%	2.0%
Social Science	1.3%	2.1%	2.5%

[a]Too few cases; estimates not provided by NSF.

SOURCE: Computed from data presented in the National Science Foundation, Women and Minorities in Science and Engineering, 1984, pp. 64-65.

Bachelor's Degrees

In 1976, blacks received 6.2 percent of all bachelor's degrees, but only 4.2 percent of all bachelor's degrees in biology (Table 3.2). Hispanics earned 2.8 percent of all bachelor's degrees in 1976 and 2.7 percent of all biology bachelor's degrees. In subsequent years, both groups increased their shares of bachelor's degrees and biology degrees. For both groups, the share of biology bachelor's degrees rose more than the share of total bachelor's degrees. In 1981, blacks earned 6.4 percent of all bachelor's degrees and 5.2 percent of the biology bachelor's degrees. Hispanics received 3.5 percent of all bachelor's degrees and 4.4 percent of the biology bachelor's degrees.

TABLE 3.2 Percentage Distribution of Bachelor's Degrees by Race and Hispanic Ethnicity

BIOLOGICAL SCIENCES

	Year			
Race/Ethnic	1976	1977	1979	1981
Black	4.2	4.5	5.0	5.2
Hispanic[a]	2.7	2.9	3.7	4.4
White	89.0	88.0	86.2	84.7
Other	4.1	4.6	5.0	5.8
Total	100.0	100.0	99.9	100.1
(Number of degrees)	(53,925)	(54,170)	(49,561)	(44,046)

ALL FIELDS

	Year			
Race/Ethnic	1976	1977	1979	1981
Black	6.2	6.3	6.5	6.4
Hispanic[a]	2.8	2.9	3.2	3.5
White	86.3	87.0	86.2	85.3
Other	3.1	3.6	4.0	4.8
Total	98.4	99.8	99.9	100.0
(Number of degrees)	(934,443)	(920,228)	(931,340)	(946,877)

[a]A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race. This category includes only U.S. citizens or permanent residents.

SOURCE: U.S. Department of Education, HEGIS Survey of Degrees and Other Formal Awards Conferred, 1976-81.

Graduate Education

At the graduate level the racial and ethnic disparities increase. The percentage of full-time biology graduate students who are minorities are presented in Table 3.3. Blacks comprised between 2.4 and 3.1 percent of the full-time biological science graduate students. Their representation among biology graduate students was measurably less than their representation among biology bachelor's degree earners. For blacks, the percentages for biology graduate enrollments in Table 3.3 fall below those for biology bachelor's degrees in Table 3.2.

A similar pattern was found for Hispanics. Their percentage of the biology graduate student population ranged between 1.2 percent and 1.7 percent (Table 3.3). This relative stability in their representation among biology graduate students occurred at the same time that their representation among biology bachelor's degree earners was rising from 2.7 percent to 4.4 percent (Table 3.2). Members of "other" minority groups were similarly underrepresented. They earned between 4.1 and 5.8 percent of the biology bachelor's degrees but accounted for less than 4 percent of the full-time biology graduate students. Only among the white nonHispanic group did the share of full-time biological sciences graduate students exceed the share of biological sciences baccalaureates.

Doctoral Degrees

The percentage of doctoral degree recipients who are black is smaller than the percentage of graduate students who are black (Table 3.4). In the late 1970s, blacks comprised between 2.4 and 3.1 percent of the full-time graduate student population in biological sciences but received less than 2.4 percent of the doctoral degrees awarded through 1980.[1]

Conclusion: The Role of the MARC Honors Program

Minority group members are underrepresented at all stages of the scientific career: undergraduate degrees, graduate enrollment, doctoral degrees, and employment in the doctorate labor force. The disparity widens appreciably after the receipt of a bachelor's degree when rates of full-time graduate study are examined. Three factors could be responsible for the increasing racial disparity as students move from undergraduate to graduate education: differences in the structure of opportunities; differences in student aspirations; and differences in student preparation. Minority and nonminority students may confront different opportunity structures as they apply to graduate schools. Institutional reputations and informal networks

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[1]Changing definitions of Hispanic ethnicity in the source survey prevent the comparison of Hispanic statistics over time.

TABLE 3.3 Percentage Distribution of Full-Time Graduate Students by Race and Hispanic Ethnicity[a]

BIOLOGICAL SCIENCES

	Year			
Race/Ethnic	Fall 1976	Fall 1978	Fall 1980	Fall 1982[b]
Black	2.4	2.3	3.1	2.8
Hispanic[c]	1.2	1.4	1.6	1.7
White	93.3	92.9	91.3	91.6
Other	3.0	3.4	3.9	3.8
Total	99.9	100.0	99.9	99.9
(Number of students)	(24,810)	(24,208)	(22,656)	(20,956)

ALL FIELDS

	Year			
Race/Ethnic	Fall 1976	Fall 1978	Fall 1980	Fall 1982
Black	5.8	5.6	5.8	5.0
Hispanic[c]	2.5	2.6	3.0	3.0
White	89.2	88.8	87.8	88.3
Other	2.6	2.9	3.4	3.6
Total	100.1	99.9	100.0	99.9
(Number of students)	(383,644)	(373,285)	(382,258)	(356,092)

[a]Excludes nonresident aliens.
[b]1982 data include agricultural sciences.
[c]A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race. This category includes only U.S. citizens or permanent residents.

SOURCE: U.S. Department of Education, Fall Enrollment in Colleges and Universities (1976, 1978, 1980). 1982 data are from unpublished tabulations supplied by the Office for Civil Rights, U.S. Department of Education.

TABLE 3.4 Percentage of Biomedical Science Research Doctorates Earned by Blacks, by Year of Doctorate

Year of Ph.D.		Biomedical Sci.[a] Total	Biomedical Sci.[a] Black	All Fields Total	All Fields Black
1973	N	3,520	64	33,755	748
	%		1.8		2.2
1974	N	3,417	69	33,047	1,010
	%		2.0		3.1
1975	N	3,515	66	32,951	1,219
	%		1.9		3.7
1976	N	3,578	74	32,946	1,316
	%		2.1		4.0
1977	N	3,465	62	31,718	1,468
	%		1.8		4.6
1978	N	3,516	79	30,873	1,391
	%		2.2		4.5
1979	N	3,644	72	31,235	1,451
	%		2.0		4.6
1980	N	3,822	83	31,013	1,447
	%		2.2		4.7
1981	N	3,843	99	31,342	1,491
	%		2.6		4.8
1982	N	3,951	94	31,048	1,525
	%		2.4		4.9

[a]The biomedical science category includes the following fields: Anatomy, Embryology, Human and Animal Physiology, Biochemistry, Molecular Biology, Biomathematics, Biometrics and Biostatistics, Biomedical Engineering, Biophysics, Environmental Sciences, Environmental Health, General Biological Sciences, Human and Animal Genetics, Immunology, Parasitology, Microbiology, Bacteriology, Neurosciences, Human and Animal Pathology, Pharmaceutical Chemistry, Human and Animal Pharmacology, Pharmacy, Public Health, Epidemiology, Hospital Administration, Veterinary Medicine, Zoology, Cell Biology/Cytology, Nutritional Sciences/Dietetics, Food Science and Technology, Endocrinology, Toxicology, Other Biological Sciences, Medicine and Surgery, Dentistry, Optometry, Ophthalmology, General Health/Medical Sciences, Other Health/Medical Sciences.

SOURCE: National Research Council, Survey of Earned Doctorates, 1973-82.

among faculty members may inflate the opportunities for students in major research institutions and deflate those for students in more isolated schools (e.g., those serving minority students). In addition to differences in opportunity, the lack of encouragement, the shortage of role models, and the absence of information about science careers may dampen minority student aspirations for graduate study. Finally, differences in preparation might also affect the rate of matriculation in graduate programs. Minority students, concentrated in financially disadvantaged institutions, may not receive the same amount of laboratory exposure, research experience, and faculty supervision that students in more affluent schools receive. These differences in curricula could affect test score performance or could influence the decision of people evaluating admissions and fellowship applications.

These three factors (opportunity, aspiration, and preparation) are explicit foci of the MARC program. MARC predoctoral fellowships (though not a subject of this analysis) provide expanded opportunity for graduate study by increasing the funding options open to minority students. The MARC Honors Undergraduate Research Training Program seeks to increase the rate of graduate study by improving institutional networks, raising aspirations, and improving the preparation of undergraduate students. The MARC program promotes these objectives by supporting special curricula, student research exposure, visiting scholars, guest lecturers, and attendance at professional meetings. In the following chapters, the operation and the outcome of these program activities are examined.

4. PROGRAM ACTIVITIES AND ACCOMPLISHMENTS: SITE VISIT PERSPECTIVES

Site visits provided an in-depth perspective on the operation of the MARC Honors Undergraduate Research Training Program. Individual programs combine campus resources and MARC funding to create a diverse array of training activities. Substantial variation was found in three areas: the use of MARC Honors resources for curriculum development; the encouragement of extramural summer research projects; and the screening of students with professional school aspirations.

Discussions with current trainees revealed great enthusiasm for the research component of the MARC Honors program. In many cases, the exposure to research resulted in decisions to pursue careers in biomedical research. The experience of working closely with faculty members was also an important influence on the trainees' academic and career plans.

Faculty members reported successful academic and scientific progress of current and former trainees. Research articles had been written by undergraduate trainees, and former trainees had gone on to graduate study at major research institutions. Beyond the personal accomplishments of the trainees, faculty members noted that the MARC Honors trainees serve as role models for other students. They felt that the Honors Undergraduate Research Training Program heightened the visibility and prestige of research on campus and stimulated an enthusiasm for science extending beyond the trainee population.

Five schools were selected for visits on the basis of their institutional and demographic characteristics. Three schools were traditionally minority institutions, two others were not. There was one doctorate-granting institution. At three other schools, the highest degree offered was a master's degree. The baccalaureate degree

was the only degree offered at one institution. Three schools had urban campuses and two had suburban or small town campuses. There were between 10,000 and 15,000 students at 4 of the 5 institutions. One school had fewer than 1,000 students. There were two private and three publicly supported institutions. Hispanics were the largest minority group in one training program and were well represented in two other programs.

Program directors at the five institutions were informed by letter that their school had been selected for a site visit. The letter described the evaluation being conducted by the Academy and briefly outlined the purpose and goals of the visit (Appendix B). A date for the visit was suggested, and final arrangements were made in a follow-up telephone call. An initial private meeting with the program director was followed by discussions with the other MARC faculty members. These meetings usually involved several faculty members in a group setting. The last part of the site visit was a meeting with the MARC Honors trainees during which faculty members were not present. Drawing upon material collected during the site visits, this chapter will focus on three topics: program activities; administrative processes; and program accomplishments.

In addition to site visits, conversations were held with MARC Honors program directors at the Fourth MARC Scholars Conference and Program Directors Meeting. Many of the issues raised during the site visits were discussed at that time and information obtained during these interviews is presented below along with the data collected during site visits.

Program Components and Activities

Each MARC Honors institution creates its own detailed plan for training. According to the guidelines established by NIH (U.S. Department of Health, Education, and Welfare, no date), the MARC Honors Undergraduate Training programs are expected to be multi-departmental and to provide a formal research experience for each trainee (including a planned program of summer research and study). Within these guidelines, the MARC Honors programs reflect the unique designs of the applicant institutions.

Stipends

Each MARC Honors trainee receives a monthly stipend.[1] The trainee stipends enable some students to stay in school who otherwise would have dropped out for financial reasons. Other students could afford to give up part-time jobs and devote more time to their studies. In some instances this resulted in higher grade point

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[1] In 1977, the stipends were $3,900 per year. At the present time (June 1985), the stipend level is $5,004 per year.

averages; in other cases it allowed students to remain in science programs and eliminated the pressure to switch to less demanding majors. The stipends were especially vital at urban institutions drawing their students from low income communities. Faculty members frequently described students who would not have been able to complete their undergraduate programs if it were not for the MARC stipend.

Laboratory Resources

Huge disparities exist in the laboratory resources of rich and poor schools. MARC Honors funds are used to purchase equipment utilized in training MARC Honors students. At schools with limited resources, nearly every major piece of equipment was purchased with MARC Honors or MBRS[2] funds. Equipment purchased with MARC Honors funds is often used in general classroom instruction as well as in conjunction with MARC Honors projects. In the absence of these grants, the opportunity to study science at these schools would be noticeably diminished.

Curriculum

MARC Honors programs enrich the curricula of grant recipient universities in several ways: guest lecturers, trainee seminars, new courses, and new course requirements. MARC Honors activities are almost always open to the entire university community. Guest lecturers from other institutions are brought in to present their research findings. Program directors and faculty members are very enthusiastic about this component of the MARC Honors program. Trainees are especially interested in hearing about the career experiences of minority group members with successful careers in science.

Most programs have special course requirements for MARC Honors students. These often include a trainee seminar in which MARC Honors trainees present the results of their research activities. The trainee seminars may also be used to introduce the students to new research techniques and laboratory instrumentation. Some programs use this seminar to introduce special topics into the curriculum (e.g., scientific writing and the use of computers in research).

The number of new courses initiated as a result of the MARC Honors program varies across schools. Fewer new courses are needed at the more established science centers. At other schools, the MARC Honors program aids the creation of new courses by supplying the funds to develop a course, providing faculty release time, or generating a

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[2] The Minority Biomedical Research Support (MBRS) program is funded by the Division of Research Resources of NIH. Its characteristics and its relationship to MARC are discussed below.

critical mass of students to support a new course offering. New courses have been established in physiology, human anatomy, mathematical biology, mathematics for biologists, and computer applications in the biological sciences.

In at least one school, the MARC Honors program provided a model for the revision of the general curriculum. However, as one program director noted, disciplinary diversity has made curriculum innovation difficult. It was his observation that many programs started out emphasizing curriculum innovation only to shift their emphasis to research training in their renewal applications.

Professional Meetings

An important facet of the MARC Honors program is the opportunity it provides trainees to attend professional meetings. These experiences are significant stimuli for personal as well as professional growth. MARC-supported travel to professional meetings affords many trainees their first opportunity for travel away from home, and it introduces them to the social as well as scientific challenges of a research career.

The major issue concerning professional meetings is how to allocate the limited travel resources. There is some disagreement over which travel experiences are the most beneficial to the trainees. Some program directors feel that more emphasis should be placed on attending major scientific meetings. They believe that MARC Honors students could and should participate in the mainstream of their chosen disciplines rather than in sheltered MARC environments. Others argue that travel to MARC- or MBRS-sponsored meetings provides the students with the opportunity to participate in the meetings rather then merely attend them.

Research Exposure: Participation in Faculty Research Projects

The MARC Honors program offers the trainees direct, firsthand exposure to scientific research. As faculty members readily acknowledge, research is not normally a part of the scientific education of undergraduates. Even on campuses with active researchers, it takes a special effort (like the MARC Honors program) to integrate undergraduate students into laboratory research. As one student remarked, "You can go through a biology program here and not know what research is like." MARC Honors students appreciate the unique opportunity that the research exposure affords them. It is the most frequently and consistently cited benefit of program participation.

The benefits of "hands on" laboratory experience have been recognized in other evaluations. In a recently completed study of precollege mathematics and science programs for women and minorities, Malcom and associates (1984) found that involving students in the "doing of science and mathematics" was the primary feature of successful programs.

MARC Honors trainees participate directly in the research activities of faculty members. They learn laboratory methods and techniques from their faculty mentors and participate in a broad range of research activities.

Research Exposure: Summer Research Projects

Involvement in research takes place all year round, but a significant research experience takes place in the summer (usually the summer before the senior year). For most students, a summer research project is conducted off-campus at a major research institution.

Special summer programs for minority college students have been in existence since the late 1960s (Malcom, et al., 1976, and Tristan et al., 1981). Biomedical research programs now exist at 19 institutions, and reports of the successful achievements of summer program alumni are now beginning to appear. Hamilton (1977) describes the results of a summer program at Oak Ridge National Laboratory that was started in 1971. Of the 60 summer students who graduated by June 1976, 23 entered medical or dental schools and 18 entered graduate programs (Hamilton, 1977).

The summer research project is one of the most valuable parts of the MARC Honors program. Students are very enthusiastic about their research and give very articulate descriptions of their projects. Frequently, these laboratory experiences have a major impact on students' career goals or research interests. At the MARC Student Symposium, a trainee noted that "our school is not very well equipped and I didn't like research. The [summer] experience at Galveston changed my attitude towards research." Students are often exposed to techniques and areas of research not available back at their home campus.

Trainees who travel to other campuses for their summer research projects report personal as well as intellectual growth. Increased self-confidence is a frequently mentioned result of the off-campus summer research experience. In the words of one MARC Honors trainee: "When we were here on campus, we knew very little. When we went away, we began to work on our own. Now that we are back, we are more independent. This independence is outside the lab, too. Once you learn to make choices for yourself, it's hard to stop."

While all MARC Honors programs have a summer research component, not all of the schools send their students to other institutions. Faculty members at the more research-oriented schools are divided over whether or not to keep students on campus for the summer. Faculty members often invest substantial amounts of time training their MARC Honors students in laboratory techniques. Having a student work in the lab through the summer can be partial repayment for the mentor's investment. At the same time, faculty members appreciate the amount of personal and intellectual growth that the students experience as the result of an off-campus research experience. One MARC faculty member expressed the dilemma directly:

> We are one of the campuses where all of the faculty are researchers. Students who leave forego the possibility of a published paper due to the interruption. Some students who leave get the benefit of a maturing experience. Not all students need to go away. I lost one of my best students through a placement at a lab across town. But what could I do? They had better equipment than I did.

Some MARC faculty members are uncertain of the type of experience the student will receive at another site, and are reluctant to gamble when a laboratory of known quality is available on campus. Several faculty members cite the advantage to the student of continuous, uninterrupted work on a single project. One faculty member pointed out that one of her students is the coauthor of an article in a major professional journal. This opportunity would have been lost had the student gone to an off-campus laboratory for his summer research experience. Another faculty member reported a similar experience:

> I'm very much in favor of students going away. But one of my students stayed and that turned out to be a tremendous benefit to me as a professional. Our work led to collaboration with a nationally known scientist. For me, this has been very fruitful as a teacher and as a researcher.

Administrative Processes

Program Directors and MARC Faculty Members

One important feature of MARC Honors programs is the enormous effort put forth by the program directors. At very little compensation, and often at a cost to other aspects of their careers, they devote substantial portions of their time to the MARC Honors program. The program serves as a focal point for faculty members' personal commitment and dedication to the educational needs of minority students. Instances were repeatedly described where faculty members assisted trainees struggling with personal or financial problems. MARC Honors programs draw upon the enthusiasm of the participating faculty members. The resources of the MARC Honors program increase the flexibility of the faculty in their efforts to advance the scientific careers of minority-group students.

Departmental Composition

The MARC Honors program is an interdisciplinary program. The departments participating in a given campus program are the result of arrangements made at each institution. Except for the universal presence of biology departments, there is no prescribed pattern. Chemistry departments are frequent participants followed by smaller numbers of psychology, mathematics, and physics departments.

There are several advantages to the interdisciplinary composition. It provides the students with a broad exposure to biomedical research and opens the MARC Honors program to a larger group of students than would be possible with a single-discipline program. The voluntary nature of departmental participation also insures that the program is not held back by less enthusiastic departments.

For the most part, the interdisciplinary orientation works well. Few problems are noted by faculty or students. Students frequently remark that they appreciate the exposure to new disciplines, new research methods, and new laboratory techniques that the MARC Honors program offers them. Problems with the interdisciplinary structure are concentrated among students from disciplines other than biology or chemistry. For these students, the ratio of familiar to unfamiliar material is probably smaller than for the more mainstream biology and chemistry students.

Computer science students are among the least enthusiastic about their MARC projects. Several report that their MARC work was unrelated to their career goals. Undergraduates in some disciplines may not have the preparation to work as peers with biomedical researchers and may be absorbed into projects in a service or support role. Comments made by computer science trainees illustrate some of these perils:

> My experience was more of an assistantship working with a statistician on a biomedical research project. Our limited background in biology was a limitation. As far as any research on my own, that was practically nil.
>
> * * *
>
> Our research interests are less well developed because we have been working outside our field rather than in computer science.
>
> * * *
>
> My project was an offshoot of a class project. I basically went off on my own and worked trial and error.

Administrative Support

The amount of support that MARC Honors programs receive from their institutions varies greatly. Some programs receive additional funds from the university. At one school, the university pays for the teaching of noncredit review courses established specially for MARC Honors students while other schools indirectly support the MARC Honors program by maintaining equipment purchased with MARC or MBRS funds. In most cases, however, the MARC Honors program provides more assistance to the general university community than it receives. On campuses where "seed money" for research is not available, MARC equipment purchases enable new faculty to initiate a research program. The existence of a MARC Honors program and the opportunity to qualify for MARC Honors traineeships is also used to help attract new students to campus.

Recruitment

Programs use a variety of methods to recruit prospective MARC Honors trainees. While formal mechanisms (campus newspaper advertisements, posters, and classroom announcements) are used, informal procedures tend to be most effective. A large portion of the MARC Honors trainees interviewed during the site visits reported learning about the program from friends and classmates. Faculty members are the second most common channel of recruitment. The dependence on informal mechanisms reflects the social patterns on many campuses. Programs on "commuter campuses" are at a disadvantage in reaching students. Some program directors obtain lists of students meeting the eligibility criteria from the registrar and approach these students about applying to the MARC Honors program.

Funding uncertainty also handicaps the recruitment efforts of the program directors. When exact funding levels are not known, program directors must chose between overrecruiting or underrecruiting. The sudden availability of funding at the last minute raises another dilemma: program directors must decide whether to "fill slots" or allow positions to remain vacant due to the absence of more desirable candidates.

Student Populations

Recruitment success is hampered more by the size of the pool of eligible students than by the strategies employed by program directors. The schools vary enormously in the number of students eligible for MARC Honors traineeships; the number of trainee positions at each institution has less variation. Smaller schools have more difficulty locating eligible students. Some of these schools have been facing declining enrollments as a result of demographic trends and school desegregation. At some of the smaller, traditionally minority institutions, the existence of a MARC Honors program is used to help attract new students to the college.

MARC Honors programs play a special role at these schools. Minority institutions have always had a unique role in the training of minority scientists. Jay (1977) described the profile of the "typical" black scientist as southern born with a baccalaureate degree from a historically black institution and then a doctorate from a majority institution. Gilford and Snyder (1977) examined the undergraduate institutions of blacks receiving doctorate degrees in the life sciences from 1973 to 1976. Every one of the 20 highest ranking undergraduate institutions was predominantly black. Recognizing this relationship between minority institutions and minority doctorate recipients, several studies have recommended the enhancement of the science curricula at these institutions (Melnick, 1977, and National Advisory Committee on Black Higher Education and Black Colleges and Universities, 1979).

One program director suggested that the students served by MARC Honors programs at historically minority schools receive more exposure

to scientific research than minority students attending major research universities because minority students at minority institutions are more likely to be interacting with researchers. Combining this environment with access to researchers and laboratories at more affluent sites through the summer placements, the MARC Honors programs provide a unique service at smaller, traditionally minority schools.

Clinical Careers

Increasing the number of minority group members pursuing research careers in the biomedical sciences is the primary objective of the MARC Honors program. This objective is complicated by the attractiveness of careers in the health professions. These professions have a clearly recognized status. (One program director reported that his institution was criticized by its alumni because too many of its graduates went on for Ph.D.s rather than M.D.s.) The exclusion of students with career goals in the health professions requires MARC Honors programs to sometimes pass over bright and promising science students. Program directors report that trainee positions sometimes went unfilled because the best candidates for them seemed likely to pursue a medical degree.

Given the desirability of MARC Honors training--in addition to the financial rewards, MARC training is popularly seen as enhancing chances for medical school admission--there is an incentive to downplay clinical aspirations in the application period. The most straightforward students place themselves at a disadvantage relative to their less candid classmates. Faculty members at different MARC Honors programs may also differ in the degree to which they probe the career plans of MARC Honors applicants. The percentage of MARC Honors trainees voicing plans for clinical careers varies across schools, suggesting variation across programs in willingness or ability to exclude students interested in the health professions.

Several MARC Honors program directors argued that exposure to research might alter the plans of the aspiring health professional. This point was made very dramatically during one site visit. All five of the members of the biology faculty had originally planned medical careers but switched after having been exposed to laboratory research. The MARC Honors program may be passing over some of the best science students--students who may become attracted to research--because of their initial inclination to attend medical school.

Several MARC Honors program directors claim that their alumni who go on to clinical or professional programs will become clinical researchers. Others add that they will become better clinicians because of their research exposure. In the words of one program director:

> MARC makes all the students more research oriented, regardless of other factors. MARC students would be better prepared as physicians and have a greater appreciation of research than the normal students.

Faculty members are well aware of the growing concern over the number of clinical researchers and of the efforts underway to increase their numbers. In recent years, there seems to be a greater willingness to accept students with plans to attend professional schools. Increasingly, students with plans for medical school are being accepted as MARC Honors trainees on the grounds that they are preparing for an M.D./Ph.D. program or because they plan a career in clinical research. One director stated that he tells applicants with plans to attend professional schools that they have a lower priority than those students seeking a Ph.D.

MARC and MBRS

Another NIH program, the Minority Biomedical Research Support (MBRS) program, was created to increase minority student, faculty, and institutional involvement in biomedical research. Undergraduate students participate in MBRS as employees on faculty research projects. Initially called the Minority Biomedical Support (MBS) program, the first awards were made in 1972. All but nine of the MARC schools have MBRS programs or are affiliated with institutions having MBRS programs.

Students occasionally move from one program to the other. Since the MARC Honors program funds only juniors or seniors, some institutions fund promising freshmen and sophomores on MBRS. Students with plans for careers in the health professions are not excluded from the MBRS programs, and schools sometimes move students between MARC and MBRS as their plans shift from clinical to research careers or vice versa. Occasionally MBRS is used to fund a student who shows strong potential, but whose grade point average is below the 3.0 required for the MARC Honors program.

Institutions vary in the degree of interconnection between MARC Honors and MBRS. At some schools, the MARC and MBRS grant holders are the same individual. In some cases, the programs function as a single entity differing only in student selection criteria and funding arrangements. Recruitment, seminars, research projects, and extracurricular activities are shared, and little distinction is made between MARC Honors and MBRS activities. At other schools, the two programs operate as fully distinct units with separate administrative structures and separate program activities. They may cooperate informally, referring students to the program for which they are most suited in terms of grade point averages and career goals, or they may operate in complete independence of one another.

Regardless of the degree of formal cooperation between the programs, MARC Honors programs build upon a pre-existing MBRS foundation. Equipment purchased under MBRS grants and faculty research supported by MBRS grants provides a base that is essential for the MARC Honors programs. This is particularly true for the least developed institutions. At these schools, most (if not all) of the research activity is supported by MBRS. If it were not for MBRS, the research environment necessary for the MARC Honors program would not be present at many program schools.

Program Outcomes and Accomplishments

Student-Faculty Interaction

The importance of role models in increasing the number of minority scientists and professionals has been noted by several researchers (Malcom et al., 1976; Green, 1976; Ashe, 1978; and Murphy and McNair, 1981). More recently, Thomas (1984) found that college students majoring in the sciences were more likely to have had earlier encounters with role models who were scientists, engineers, doctors, or lawyers. Reviewing several studies of the career choices of minorities and women, Thomas suggested that minorities and women choose some fields over others because adequate representation of women and minorities is related to a perception of less discrimination and greater opportunity for advancement. The shortage of minority scientists and mentors may do more than just dampen aspirations. Blackwell (1981) noted that the importance of personal references in academia (the "old boy network") tends to work against minority students, especially those from minority institutions.

The MARC Honors program is an important vehicle for encouraging and enhancing student-faculty interaction. This is a particularly important part of the MARC Honors experience at newer and larger urban institutions. Students get to know faculty members on a personal basis. As one student remarked, "I used to go home right after class. Now I spend time in the lab. I get to know what the professors are like." Another student noted that the "role model impact of MARC is important. It enables us to see members of our own ethnic group as scientists. Success does not seem so formidable." The life of a researcher is demystified; trainees are able to identify with their mentors and come to appreciate the benefits and attainability of a research career. Students receive encouragement from the faculty and learn that they are wanted, that the world of research is open to them.

Publications

The publication of research findings is a major accomplishment for an undergraduate student. At almost every institution visited, MARC Honors students are coauthoring scientific papers and presenting their work at scientific meetings. Achievements of this level are found only among MARC Honors and MBRS students at the schools visited. One faculty member reported that two of her MARC Honors undergraduate students will be presenting their work at a national meeting of a scientific society, the first undergraduates in the history of the society to do so.

Awareness of Research and Research Careers

MARC Honors programs, by virtue of their visibility and prestige, have increased the awareness of research careers on campus and have

enhanced the esteem in which they are held. One program director reported a significant increase in the number of students with research orientations since the establishment of the MARC Honors program. "The knowledge that MARC has graduate school goals has increased interest in graduate school." Another program director observed that "over 90 percent of our biology and chemistry majors are premed. MARC students have done a lot to dispel the view that graduate school is less prestigious than medical school."

At newly established universities, the MARC Honors program provides a nucleus for the development of a "science subculture." At urban schools it helps the trainees to break out of the commuter pattern and facilitates an academic environment similar to that found on residential campuses. The impersonal atmosphere of the urban campus is transcended. The trainees learn from each other and help to socialize one another into the norms and practices of science. The impact has spread beyond the MARC Honors trainees and at several schools, faculty members report a greater interest in research among nonMARC students. Scientific honor societies on two campuses received new energy as a result of the enthusiasm for science scholarship generated by the MARC Honors program.

The traineeship also gives the student a special status, an identity on campus. The MARC Honors trainees at some schools form an identifiable group and receive recognition from their peers for being part of an academic elite. This reinforces their identity as future scientists. The presence of MARC Honors students in the classroom provides nontrainees with a standard of performance and stimulates a healthy competition among the students.

The Demand for MARC Honors Students

One indicator of the success of the MARC Honors program is the high level of demand for MARC trainees. At the MARC Scholars Conference, the trainees are besieged by recruiters from dozens of major research universities. MARC program directors also report that they are approached with inquiries about their trainees from graduate schools.

Fellowship opportunities also seem abundant for former MARC Honors trainees. A MARC predoctoral fellowship program (separate from the Honors Undergraduate Research Training Program) was established by NIH. Recently, there has been some concern expressed over the small number of applicants. Many of the program directors attribute the low level of predoctoral fellowship applications to the success in getting MARC Honors students into the education mainstream. Graduate schools offer financial support to the MARC Honors graduates as part of their recruitment effort. Given the success experienced by the trainees in securing their own predoctoral funding, many program directors support the idea that some of the funds currently earmarked for predoctoral fellowships be used to fund more undergraduate trainees.

There is also a healthy competition for MARC Honors students among the large (and growing) number of schools that run summer training

programs for minority students. Professor Victor Rodwell, director of a summer institute at Purdue University, has compiled a list of 19 such programs. Another 11 programs are in the planning stages. These summer institutes are not funded by MARC, yet MARC Honors programs are a major source of participants. The willingness of so many institutions to invest in the training of MARC Honors students may be seen as a positive reflection on the quality of the trainees. Program directors also report a strong interest from the business community in providing summer internships for MARC Honors trainees.

Institutional Linkages

The MARC Honors program has helped to link teachers and researchers at grantee institutions to colleagues on other campuses. Funds to bring in outside lecturers have reduced the professional isolation of faculty members at many MARC Honors campuses. At one institution, a new course taught by faculty members from a nearby university and paid for by MARC Honors funds produced greater professional contact between the faculty members of the two schools and resulted in the opportunity for students at the MARC school to use sophisticated scientific instruments at the other institution. The Annual Student Symposium and Program Directors Meeting also provides the opportunity for the faculty members to discuss their training activities and to compare experiences. An organization of MARC Honors program directors has evolved from these meetings, and a newsletter has been established to exchange information about training activities.

Valuable personal and professional contacts are also made during the summer research programs. The off-campus summer research experiences also serve as an aid to graduate school admission and recruiting. The summer project is an opportunity for both students and graduate programs to take a close look at each other. In addition to the useful contacts made by individual students in summer research programs, faculty members at less established schools expressed the belief that the MARC summer placements broke down stereotypes of their institutions and enhanced their school's reputation in wider scientific circles.

In some cases, relationships established by students on their summer projects have led to contacts between faculty members of the MARC and the summer institutions. Several of these contacts have been very beneficial to the research activities of MARC Honors faculty members. One program director reported that, as a result of summer program exposure to MARC Honors trainees from his school, a faculty member from a major research institution has decided to come to the program director's school to teach for a semester.

Conclusions

The MARC Honors Undergraduate Research Training Program has produced a diverse array of training programs adapted to the unique

needs of the recipient institutions and their students. MARC Honors funding (often in conjunction with MBRS resources) facilitates and enhances the research training efforts of faculty members and program directors. Guest speakers are brought to campus, laboratory equipment is purchased, new courses are developed, and institutional links are forged. In addition to an enhanced science curriculum, the MARC Honors trainees receive direct assistance in their pursuit of science careers: stipends, laboratory experience, close contact with researchers, and exposure to professional settings (seminars, conferences, and meetings).

The MARC Honors trainees are very enthusiastic about the research experience they gain as a part of the MARC Honors program. Many students credit the research exposure as the chief determinant of their decision to pursue a research career. Working on a one-to-one basis with a faculty member, the trainees were able to see the attractions and desirability of a research career.

Faculty members are also enthusiastic about the MARC Honors program because it makes research a part of the undergraduate science curriculum. They see the work of the MARC Honors trainees (both in the laboratory and in the classroom) as providing a model for the other students. The MARC Honors program heightens the visibility and prestige of scientific research on many campuses and promotes a new interest in science that extends beyond the trainee population.

In addition to the testimony of students and faculty, there are other indicators of the success of MARC Honors training efforts. Trainees are coauthoring publications based on their research. This had not been the case at these institutions before the initiation of the MARC Honors program. The demand for MARC Honors students (who are sought out by summer program directors and graduate school recruiters) is further evidence of the quality of the trainees.

There are, however, some unresolved questions about program eligibility and program activities. The location of the summer research experience is an important issue. The most crucial issues concern who is to be trained. Some students in fields other than biology and chemistry are not well integrated into research activities. At the present time there are wide variations across programs in the admission of preprofessional students.

5. SURVEY OF FORMER MARC HONORS TRAINEES

A survey of former MARC Honors trainees was conducted to collect data on educational and career achievements. Over three-fourths of the respondents reported having attended graduate or professional school since leaving the MARC Honors program. Nearly one-half of the respondents (47.6 percent) were current students in doctoral programs or holders of doctorate degrees. Another 15.1 percent were currently enrolled in master's degree programs. A large fraction of the respondents (35.7 percent) expected to be in research careers at age 35.

Not all of the respondents are likely to enter research careers. Many of the former trainees in doctoral programs are seeking professional degrees (most often M.D. degrees). Thirteen percent of the students in professional doctorate programs expected to be in research careers at age 35.

The former MARC Honors trainees reported a high level of satisfaction with all program activities. Research exposure and close contact with faculty members were acknowledged as especially significant benefits of program participation.

Design and Methodology

The primary purpose of the survey of former MARC Honors trainees was to collect data on educational and career achievements. Secondary objectives were to ascertain the trainees' exposure to the various elements of the MARC Honors program (e.g., on-campus research, off-campus summer research, special seminars, and attendance at scientific meetings) and to obtain the students' evaluation of these program components.

The questionnaire was drafted in March 1984 and on March 16 a pretest was conducted using nine current MARC Honors trainees at Howard University. Revisions were made, and copies of the revised questionnaire were sent to the members of the Committee on National Needs for Biomedical and Behavioral Research Personnel. Comments made by the committee members at the May 11, 1984 meeting were incorporated into the questionnaire.

In accordance with the provisions of the Paperwork Reduction Act (5 CFR 1320), a request for survey clearance was prepared, and the questionnaire along with supporting documentation were submitted to NIH for transmission to the Office of Management and Budget (OMB). On September 17, 1984, OMB approved the survey of former MARC Honors trainees subject to modifications on two survey items. These modifications were made. (A copy of the survey instrument and the cover letters that accompanied the questionnaire are presented in Appendix C.) A request for permission to survey a comparison group of nonMARC science graduates at MARC Honors schools was not approved by OMB.[1]

Mailing addresses for the former trainees were obtained from MARC Honors program records at NIH. Address information was also obtained from MARC Honors program directors and from alumni offices at participating institutions. The examination of the MARC Honors program files yielded the names and addresses of 821 former trainees. These were all of the trainees who graduated or left the program prior to August 1984. In the case of current trainees, estimates of graduation dates were made. The decision to study "exit cohorts" was based on the initial plan to match MARC Honors trainees with nonMARC science graduates from the same institution.

Survey Procedures

The initial wave of questionnaires was mailed on November 14, 1984 to the addresses provided by the program directors. Since many program directors maintain close contact with their former trainees, addresses obtained from the program directors (when available) were given the highest priority. When undeliverable questionnaires were returned to the NAS, they were remailed to the next priority address.

The response rate for the first mailing was very low, and a major effort was made to verify the addresses for the second mailing. Telephone directories and directory assistance were used to determine if a person with the same last name was listed at the given address. Verified addresses were given priority over unverified addresses. The second mailing was done over a two-week period beginning January 8, 1985.

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[1]OMB contended that "the study design did not provide for adequately matching MARC Honors trainees with a population of like characteristics." The study design called for selecting a comparison group from the population of honors students in the same departments, schools, and graduation cohorts as the trainees. Any differences in measured attributes (e.g., grade point average) were to be subject to statistical controls or restricted comparisons. The committee's staff challenged the OMB decision. However, given the length of time between the original submission of clearance materials and an OMB ruling, it was determined that a formal appeal of the decision was not feasible.

Efforts to track the addresses of former trainees continued. In January 1985, the program directors were recontacted and asked for assistance in verifying or updating the addresses. These data were used for a final round of address searches conducted prior to the third mailout.

In February, phone calls were made using the phone numbers obtained in the verification process. If the former trainee was contacted, his or her participation in the survey was requested. Forwarding information was sought in cases where the trainee had moved. The third and final mailing took place in March 1985.

Response Rate

Nearly two-thirds of the former MARC Honors trainees (65.0 percent) returned their questionnaires. A comparison of the attributes of survey respondents to those of nonrespondents can provide a perspective on the adequacy of the survey response rate. Data on program participation from NIH training records and trainee grade point averages (GPAs) from the MARC Honors grant renewal applications can be used for this purpose.

Almost all of the differences between respondents and nonrespondents were minor. The most recent trainees were slightly more likely to respond than the less recent program participants (Appendix D, Table D.1). These differences were small, and the response rates for four of the seven entry cohorts were within three percentage points of the grand mean. Large deviations from the overall mean (15 percentage points) were found only in the first and last cohorts. There was only a slight difference in the GPA of respondents and nonrespondents. The mean GPA of respondents was 3.33 while that of the nonrespondents was 3.18 (Appendix D, Table D.2). Respondents spent an average of 16.5 months on the training grant while nonrespondents averaged 15.0 months (Appendix D, Table D.3). However, the respondents were more likely than the nonrespondents to have received predoctoral support from NIH in graduate school. Of the 188 trainees who left the MARC Honors program before 1981, 12.5 percent of the respondents and 3.6 percent of the nonrespondents had NIH predoctoral support in 1981.

An additional perspective on response bias can be obtained by comparing the survey respondents' rate of medical school attendance to that of the entire study population. The Association of American Medical Colleges (AAMC) was able to determine that 184 former MARC Honors trainees were accepted at medical schools (22.4 percent). A similar percentage of survey respondents (28.3 percent) report medical degrees, current medical school enrollment, or withdrawal from professional schools.

Some indication of the reliability of the respondents' data can be obtained by comparing the program directors' reports of students' GPA with the students' reports of their own GPA. There is a strong correspondence between the two reports. In 70.1 percent of the cases the students and program directors reported the same GPA. Almost all

of the discrepancies were within one category on the GPA scale. In cases where discrepancies occurred, the students' reports of their GPAs tended to be higher than those of the program director (Appendix D, Table D.4). It should be noted that the GPAs in the program directors' reports were not always the final GPA. Some of the discrepancies may have been due to changes that occurred after the program directors' report.

Survey Results[2]

Background

The MARC Honors respondents were nearly equally divided between males and females (45.0 percent male, 55.0 percent female). Blacks were the largest racial/ethnic group, comprising 74.1 percent (Table 5.1). Hispanics were the second largest group, making up 17.2 percent of the survey respondents. Asian Americans and Native Americans comprised smaller portions of the sample (3.3 percent and 2.6 percent, respectively.)

Education

Over three-quarters of all former MARC Honors trainees (76.1 percent) matriculated as students in a graduate or a professional school program (Table 5.2). There has been some fluctuation over time in the rate of postbaccalaureate training. However, former trainees from the earliest program cohorts have had more time in which to enroll in postbaccalaureate programs.

Since the first MARC Honors cohort graduated in 1978 (and the first full, two-year trainee cohort did not graduate until 1979), there has been limited time in which to complete doctorate work. Nonetheless, 22 former trainees from the first three graduating cohorts have completed their doctorate degrees. These 22 doctorate holders represent 21.2 percent of the respondents who graduated (or left) the MARC Honors program during its first 3 years of operation.[3] Another 30 former trainees from these program cohorts are still in doctoral programs.

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[2]Because it was necessary to estimate the graduation date of many trainees in the creation of the initial study population, 36 current MARC Honors students received and returned questionnaires. Since current students were not included in the initial design of the study population, these cases are excluded from the analysis. The results presented below are based on the responses of 498 former MARC Honors trainees.

[3]There were 104 respondents in the first 3 graduation cohorts, 1978 through 1980. To facilitate later comparisons with NSF data, Table 5.2 groups the years 1978 through 1981.

TABLE 5.1 MARC Respondents by Racial/Ethnic Group and Sex

Racial/Ethnic Group		Sex		
		Total	Male	Female
Black	N	321	118	203
	%	64.4	52.7	74.1
Hispanic[a]	N	112	65	47
	%	22.5	29.0	17.2
Asian	N	28	19	9
	%	5.6	8.5	3.3
Native American	N	23	16	7
	%	4.6	7.1	2.6
Other, No Response	N	14	6	8
	%	2.8	2.7	2.9
Total	N	498	224	274
	%	99.9	100.0	100.0

[a]Includes all those indicating Hispanic ethnicity, regardless of race.

TABLE 5.2 Percent Ever Enrolled in Postbaccalaureate Training by Year of Exit from MARC Honors Program[a]

Academic Year	Number	Percent
1978	13	86.7
1979	26	83.9
1980	47	81.0
1981	45	69.2
1982	83	78.3
1983	79	77.5
1984	86	71.1
Total	379	76.1

[a]Includes current graduate students, current professional students, holders of graduate degrees (e.g., M.S., Ph.D.), holders of professional degrees (e.g., M.D.), and former students who withdrew from graduate or professional schools without receiving degrees.

SOURCE: MARC Honors Survey.

Holders of medical degrees greatly outnumber holders of research doctorates. This is in part a function of the number of years required to complete doctoral work in each program. Professional doctorates typically require 4 years of postbaccalaureate study; the median time from baccalaureate degree to Ph.D. in the biosciences is 7.4 years (National Research Council, 1983).

Sixty-five percent of the respondents are students, the vast majority being degree-seeking graduate or professional students (Table 5.3). Over one-fourth of the former trainees are doctoral students in professional schools.[4] A slightly smaller percentage (17.3 percent) are enrolled in research doctorate programs. However, another 15.1 percent of the former trainees are in master's degree programs. Most of these students are in basic sciences programs.

By 1981, 16 trainees had gone on to receive NIH/ADAMHA predoctoral support under a National Research Service Award Act program. They

TABLE 5.3 Educational Status of Former Trainees

	Year of Program Exit					
	Total		1978-1981		1982-1984	
Status	No.	%	No.	%	No.	%
Doctorate Holders						
Research (Ph.D.)	1	0.2	1	0.7	0	0.0
Professional (M.D., D.D.S., D.V.M.)	21	4.2	21	14.8	0	0.0
Current Graduate Students						
Master's	75	15.1	17	12.0	58	16.3
Research Doctorate	86	17.3	23	16.2	63	17.7
Professional Doctorate	126	25.3	27	19.0	99	27.8
Other Professional	3	0.6	2	1.4	1	0.3
M.D./Ph.D.	3	0.6	0	0.0	3	0.8
Other Students						
Nondegree	15	3.0	8	5.6	7	2.0
2nd Bachelor's	14	2.8	5	3.5	9	2.5
None of the above	154	30.9	38	26.8	116	32.3
Total	498	100.0	142	100.0	356	99.7

SOURCE: MARC Honors Survey.

[4]Most of these were medical students. A few of the students in professional doctorate programs (7.1 percent) were studying dentistry and 2 students (1.6 percent) were studying other health fields.

represent 8.5 percent of the 188 persons who left the MARC Honors program before 1981. Twelve of these predoctoral students are supported on training grants; four have fellowship grants. NIGMS supports the largest number of predoctoral students (eight), followed by NIMH (five). National Heart, Lung, and Blood Institute, National Cancer Institute, and National Institute of Child Health and Human Development also support former MARC trainees.

While the Office of Management and Budget would not approve a survey of a comparison group of science students, the New Entrants Survey (NES) of the National Science Foundation (NSF) can provide some perspective on the rate of graduate school attendance for the former MARC Honors trainees. The New Entrants Surveys conducted by the National Science Foundation in 1980 and 1982 produced national estimates of the educational activities of the science majors graduating one to two years before each survey. The rate of graduate or professional school attendance for biology baccalaureates ranged between 53.2 percent and 43.9 percent for the 1978, 1979, 1980, and 1981 graduating classes (Table 5.4). Weighted averages for the five fields represented in MARC Honors programs (biology, chemistry, psychology, mathematics, and physics) yielded results similar to those for biology baccalaureates.

The rate of graduate or professional school attendance for former MARC Honors students was well above that of the New Entrants Survey sample. Almost two-thirds (64.1 percent) of the MARC Honors trainees graduating in the 1978 through 1981 period were doctorate degree holders or current graduate and professional students in 1984. (An even larger percentage had enrolled in graduate school at some point since leaving the MARC Honors program.) Among the former trainees from the 1982 through 1984 MARC Honors cohorts (who, like the New Entrants sample, have been out of school for less than two years), the rate of graduate or professional school attendance for 1984 was 63.2 percent.

The comparison with national averages provides a perspective on the MARC Honors graduates: MARC Honors graduates are more likely to attend graduate or professional school than the typical science graduate. However, the data presented above cannot determine the extent to which credit belongs to the training program. Unmeasured differences between the MARC Honors graduates and the New Entrants sample prevent the use of the latter as a rigorous test of the MARC Honors program's success. Differences in the time elapsed between graduation and survey dates also complicate comparisons.

Withdrawal from Graduate and Professional Schools

Many graduate students withdraw from graduate or professional programs before they have completed them. Since many former MARC Honors trainees are still in school, the graduate and professional school attrition rate can certainly change. At the present stage, attrition from a graduate or professional program does not seem to be a common characteristic of the survey respondents. Eighty-four of the respondents reported that they left a graduate or professional program before

TABLE 5.4 Graduate or Professional School Status of Recent Science Bachelor's Degree Recipients (Total U.S.)

	Survey Year and Year of Bachelor's Degree			
	1980 Survey		1982 Survey	
	1978 Graduates	1979 Graduates	1980 Graduates	1981 Graduates
Field	Percent	Percent	Percent	Percent
BIOLOGY				
Full-Time	44.0	39.2	37.9	42.6
Part-Time	8.7	4.7	12.0	10.6
Other/No Response	47.2	56.1	50.1	46.8
Total[a]	99.9	100.0	100.0	100.0
ALL MARC FIELDS[b]				
Full-Time	41.7	38.6	37.1	42.7
Part-Time	9.0	6.2	12.9	11.8
Other/No Response	49.3	55.2	50.0	45.5
Total	100.0	100.0	100.0	100.0

[a]Due to rounding by NSF, detail may not add to total.

[b]The percentages from five science fields were weighted according to their proportion of the majors in the MARC Honors program (biology = .604, chemistry = .243, psychology = .069, mathematics = .061, and physics = .024).

SOURCES: National Science Foundation, 1982 and 1984a; Tables B-1, B-4, B-19, and B-22.

they received a degree. This group represents 16.9 percent of the respondents and 22.2 percent of those who had ever enrolled in a graduate or professional school program. Attrition was greatest from master's degree programs followed by smaller numbers who left doctoral programs (Table 5.5).

Former MARC Honors trainees left graduate or professional programs for a variety of reasons (sometimes to enroll in other programs and sometimes with the intention to return to school later). The greatest number who left graduate school withdrew from master's rather than doctoral programs. The reasons for leaving graduate or professional programs were ascertained in two ways: first by an open-ended question and next by a multiple choice question. Lack of interest in the program and external factors (family, health, and other personal reasons) were the most frequently cited reasons for leaving graduate or professional programs (Table 5.6). Educational expenses and expectations of future earnings were frequently checked in the multiple choice question. In the open-ended question that preceded it, however, these reasons were rarely mentioned. Other economic reasons were given instead. Respondents mentioned that they needed to work or that classes interfered with their jobs. These statements probably reflect the situation of people in master's degree programs (a large fraction of those who left graduate or professional programs). Students in master's degree programs are less likely to be on stipends and more likely to be bearing the cost of their education directly. The major reasons for leaving--lack of interest and external factors--do not suggest immediate policy changes. There is evidence, however, that the lack of funding and the need for outside employment conflict with the educational plans of some students.

Not all of those who left graduate or professional programs should be viewed as unsuccessful. Ten percent of the students who left graduate or professional programs reported that they did so because they were accepted at medical schools or other professional programs. Another group, almost as large, reported that they have changed their career plans without mentioning their new field. Some of these people will go on to successful scientific careers. Of the 84 people who left a graduate or professional program prior to receiving a degree, 1 later received a medical degree and 39 others were back in school as of November 1984. Twelve were in professional doctorate programs, six were in research doctorate programs, thirteen were in master's degree programs, and eight were in nondegree or second baccalaureate programs.

Employment

The former MARC Honors trainees were asked about their employment status as of November 12, 1984. Since the overwhelming majority of the respondents were in school, their current labor force status was a poor indicator of their career progress. However, it is useful to look at the employment status of those persons no longer enrolled in school.

Very few MARC Honors survey respondents reported that they were not employed as of November 12, 1984 and those that did were almost all persons without graduate or professional degrees (Table 5.7). None of the doctorate holders and only three of the master's degree

TABLE 5.5 Persons Leaving Graduate or Professional School Before Receiving Degree by Type of Program

Type of Program	Number	Percent
Master's Degree	46	
Research Doctorate	21	25.0
Professional Doctorate	16	19.0
M.D./Ph.D.	1	1.2
Total	84	100.0

SOURCE: MARC Honors Survey.

TABLE 5.6 Reasons for Leaving Graduate or Professional School Before Receiving Degree

	Open-Ended Responses		Precoded Responses	
Reason	N	%	N	%
Lack of interest in program	24	25.8	27	22.5
External factors (e.g., family, health)	20	21.5	33	27.5
Educational expenses	4	4.3	26	21.7
Lack of preparation for program	4	4.3	17	14.2
Expectations of future earnings	2	2.2	17	14.2
Changed career plans	6	6.5	-	-
Accepted at medical (or other professional) school	8	8.6	-	-
Academic reasons (lack of progress)	5	5.4	-	-
Financial reasons (needed to work)	10	10.8	-	-
Classes conflicted with job	3	3.2	-	-
Other	7	7.5	-	-
Total[a]	93	100.1	120	100.1

[a]Eighty-four people left graduate or professional programs. Several of these people gave more than one reason for leaving.

SOURCE: MARC Honors Survey.

TABLE 5.7 Labor Force Status by Education for Former Trainees No Longer Enrolled in School

Year of Exit from Program/Employment Status	Highest Degree: No B.A. N	No B.A. %	Bachelor's N	Bachelor's %	Master's N	Master's %	Doctorate N	Doctorate %	Total N	Total %
ALL YEARS										
Employment Status										
Unemployed	2	15.4	11	9.3	3	16.7	0	0.0	16	9.5
Employed	11	84.6	107	90.7	15	83.3	20	100.0	153	90.5
Total Labor Force	13	100.0	118	100.0	18	100.0	20	100.0	169	100.0
Field of Employment										
Science/Engineering	8	72.7	69	64.5	12	80.0	20	100.0	109	71.2
Other	3	27.3	38	35.5	3	20.0	0	0.0	44	28.8
Total Employed	11	100.0	107	100.0	15	100.0	20	100.0	153	100.0
1978-1981										
Employment Status										
Unemployed	1	20.0	2	4.6	3	20.0	0	0.0	6	7.1
Employed	4	80.0	42	95.5	12	80.0	20	100.0	78	92.9
Total Labor Force	5	100.0	44	100.0	15	100.0	20	100.0	84	100.0
Field of Employment										
Science/Engineering	1	25.0	26	61.9	11	91.7	20	100.0	58	74.4
Other	3	75.0	16	38.1	1	8.3	0	0.0	20	25.6
Total Employed	4	100.0	42	100.0	12	100.0	20	100.0	78	100.0
1981-1984										
Employment Status										
Unemployed	1	12.5	9	12.2	0	0.0	-	-	10	11.8
Employed	7	87.5	65	87.8	3	100.0	-	-	75	88.2
Total Labor Force	8	100.0	74	100.0	3	100.0	-	-	85	100.0
Field of Employment										
Science/Engineering	7	100.0	43	66.2	1	33.3	-	-	51	68.0
Other	0	0.0	22	33.8	2	66.7	-	-	24	32.0
Total Employed	7	100.0	65	100.0	3	100.0	-	-	75	100.0

SOURCE: MARC Honors Survey.

holders were unemployed. Among those whose highest degree was a bachelor's degree, 11 people (9.3 percent) were unemployed. (Four people were not in the labor force.)

National estimates of the employment status of science students were obtained from the New Entrants Surveys conducted by the National Science Foundation in 1980 and 1982 (Table 5.8). The unemployment rate for biology baccalaureates 1 to 2 years after graduation ranged from a low of 3.3 percent (1978 graduates surveyed in 1980) to a high of 11.7 percent (1981 graduates surveyed in 1982). The rates for a weighted combination of MARC Honors fields (biology, chemistry, psychology, mathematics, and physics) were similar. These figures correspond closely to those for former MARC trainees with bachelor's degrees. Among the 1978-81 MARC Honors trainees with bachelor's degrees only, the unemployment rate was 4.6 percent. For the more recent MARC Honors trainees (1982-84), the unemployment rate was 12.2 percent for those whose highest degree was a bachelor's degree.

The majority of the MARC Honors survey respondents who were not in school were employed in science or engineering jobs (Table 5.7). All of the doctorate holders and 80.0 percent of the employed master's degree holders were in science and engineering positions. Those with only a bachelor's degree were least likely to have jobs in science and engineering (64.5 percent). However, this rate exceeds the national average for recent science baccalaureates. In 1980, 46.6 percent of the employed biology baccalaureates from the class of 1978 held science or engineering jobs (Table 5.8[5]). A similar rate (47.9 percent) was found for the 1979 graduates. A 1982 survey found that the level of science or engineering employment was 50.0 percent for 1980 graduates and 46.2 percent for 1981 graduates. Nationally, the percentage in scientific employment was higher for mathematics, chemistry, and physics majors than it was for biology and psychology majors. When the rates are adjusted to compensate for the field distribution of MARC Honors trainees, the levels of scientific employment fell between 54.3 and 57.5 percent. This was still substantially lower than the level of the former MARC trainees.

Career Plans

When asked about their expected field of employment at age 35, nearly all of the respondents mentioned science-related jobs (Table 5.9). Nearly 25 percent aspired to biomedical research careers and another 10.6 percent planned research in other fields participating in MARC Honors programs (e.g., chemistry, physics, psychology, and mathematics).

Clinical careers in the health sciences were mentioned by over 40 percent of the sample. Medicine was the most frequently cited (31.1 percent). Dentistry and other health professions (nursing, pharmacy, and podiatry) were listed by another 10 percent. Nonclinical careers in science-related fields (usually engineering and computer science) were mentioned by 14.3 percent of the respondents.

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[5]These figures exclude full-time graduate students.

TABLE 5.8 Labor Force Status of Recent Science Bachelor's Degree Recipients Who Are Not Full-Time Graduate Students (Total U.S.)

Field/Labor Force Status	Survey Year and Year of Bachelor's Degree			
	1980 Survey		1982 Survey	
	1978 Graduates	1979 Graduates	1980 Graduates	1981 Graduates
	Percent	Percent	Percent	Percent
BIOLOGY				
Employment Status				
Unemployed	3.3	6.5	6.7	11.7
Employed	96.7	93.5	93.3	88.3
Total Labor Force	100.0	100.0	100.0	100.0
Field of Employment				
Science/Engineering	46.6	47.9	50.0	46.2
Other	53.4	52.1	50.0	53.8
Total Employed	100.0	100.0	100.0	100.0
ALL MARC FIELDS[a]				
Employment Status				
Unemployed	3.4	4.8	5.6	11.1
Employed	96.7	95.3	94.5	89.0
Total Labor Force[b]	100.1	100.1	100.1	100.1
Field of Employment				
Science/Engineering	54.3	55.2	56.2	57.5
Other	45.8	45.8	43.9	42.5
Total Employed	100.1	101.0	100.1	100.0

[a]The percentages from five science fields were weighted according to their proportion of the majors in the MARC Honors program (biology = .604, chemistry = .243, psychology = .069, mathematics = .061, and physics = .024).
[b]Due to rounding by NSF, detail may not add to total.

SOURCES: National Science Foundation, 1982 and 1984a; Tables B-1, B-4, B-19, and B-22.

A sizable number of respondents reported academic medicine or clinical research as a primary career goal. (These individuals were counted with the researchers and not the clinicians in Table 5.9.) Of the 146 former trainees who were enrolled in professional doctorate programs (medical, dental, or veterinary schools) or who have finished their professional training, 19 (13.0 percent) reported that they expect to be doing research at age 35.

TABLE 5.9 Expected Area of Employment at Age 35

Type of Employment	Percent
I. Science/Engineering Jobs[a]	
A. Research	
1. Biomedical	24.7
2. Other fields (e.g., chemistry, physics, psychology)	10.6
3. Unspecified	0.4
B. Nonresearch	
1. Clinical	
a. Medicine	31.1
b. Dentistry	2.7
c. Other health	7.8
2. Nonclinical	14.3
C. Science (research content unspecified)	1.0
II. Nonscience/Engineering Jobs	7.4
	100.0

[a]These codes are derived from the job names given in Question 12 on the survey instrument.

SOURCE: MARC Honors Survey.

Career Progress

Given the different years of graduation and the different stages of career progress, it is difficult to measure program success with a single number. Time and opportunity are intertwined with each indicator of career success. Nevertheless, it is interesting to summarize the status of former trainees.

Table 5.10 presents three measures of program success. The first and most restrictive measure, doctoral enrollment, counts the number of former trainees who were either currently enrolled in doctoral programs or who had completed doctoral programs. Almost half of the former trainees were in doctoral programs. Students in clinical programs outnumbered students in research doctorate programs.

TABLE 5.10 Percentage of Respondents in Each Career Outcome Category by Year of Exit From MARC Honors Program

	Career Outcomes					
	Doctoral Enrollment[a]		Doctoral Progress[b]		Doctoral Plans[c]	
Year of Exit	Yes	No	Yes	No	Yes	No
1978	46.7	53.3	46.7	53.3	53.3	46.7
1979	51.6	48.4	51.6	48.4	71.0	29.0
1980	46.6	53.5	56.9	43.1	67.2	32.8
1981	33.9	66.2	50.8	49.2	72.3	27.7
1982	50.9	49.1	66.0	34.0	87.7	12.3
1983	47.1	52.9	66.7	33.3	89.2	10.8
1984	52.1	47.9	70.3	29.8	90.1	9.9
Total	47.6	52.4	62.7	37.4	82.1	17.9

[a]Completed or currently enrolled in doctoral program.
[b]Includes master's degree students.
[c]Graduate students, current and prospective.

SOURCE: MARC Honors Survey.

A sizable group of students (15.1 percent) were in master's degree programs. Although some of these students may end their education with master's degrees and others may go on to professional schools, a portion of these students will pursue research doctorates. Adding the master's degree seekers to the population in doctoral programs raised the percentage in a more broadly defined measure of success, doctoral progress, to over 60 percent.

Graduate education is not a single, uninterrupted sequence. At all levels of higher education, and particularly at the graduate level, students return to school and obtain their degrees after a period of employment, family responsibility, or leisure. Of the 37.0 percent of the former trainees who were not currently degree-seeking students, over half planned to return to school and obtain doctoral degrees before they reach 35. When those planning doctoral degrees were included in a third measure of success called doctoral plans, over 82 percent of the respondents qualified.

Success (measured either by doctoral enrollment, doctoral progress, or doctoral plans) was related to both grade point average (GPA) and months of funding on the MARC Honors programs. Students with the highest self-reported GPA were the most likely to be enrolled in graduate or professional programs (66.7 percent), making doctoral progress (77.8 percent), or having doctoral plans (86.1 percent). Respondents with lower GPAs were less likely to report "successful" outcomes. The relationship between GPA and success was particularly strong for the two most restrictive definitions of success, enrollment in a doctoral program and doctoral progress (Table 5.11, panel A).

Those respondents with the greatest number of months in the program also had the highest rates of success (Table 5.11, panel B). Although the relationship was not quite as strong as that of GPA, former trainees with 24 months of MARC funding were the most likely to be enrolled in doctoral programs (58.7 percent), making progress toward a doctoral degree (70.1 percent), or having doctoral plans (89.1 percent). Those with less program exposure were less likely to report each of these career outcomes.

The relationship between program tenure and success is interesting. Those with the most program exposure were the most likely to pursue graduate or professional degrees. Although the relationship was strong, its interpretation is not very simple. It is quite possible that those with the greatest potential for success were spotted earliest in their undergraduate careers and given the most program exposure. Those with less promise may be added to the programs in their senior year to fill program vacancies. Furthermore, the attrition of the less interested and less successful students from the MARC Honors program will also increase the relationship between program exposure and success. Although the relationship between success and program exposure suggests the possibility of direct program benefits, the alternative possibilities of program selection and selective attrition cannot be ruled out as sources of the observed relationship.

TABLE 5.11 Percentage of Respondents in Each Career Outcome Category by Grade Point Average and Months in Program

	Career Outcomes					
	Doctoral Enrollment[a]		Doctoral Progress[b]		Doctoral Plans[c]	
	Yes	No	Yes	No	Yes	No
A. Grade Point Average (Q28)						
A	66.7	33.3	77.8	22.2	86.1	13.9
A/B	50.4	49.6	65.9	34.1	84.5	15.5
B	29.5	71.5	49.2	50.8	77.9	22.1
B/C	18.2	81.8	18.2	81.8	54.6	45.4
C or less	0.0	100.0	0.0	100.0	66.7	33.3
B. Months in Program (Q24a)						
24	58.7	41.3	70.1	29.9	89.1	10.9
18-23	40.2	59.8	56.7	43.3	82.5	17.5
12-17	45.8	54.2	65.0	35.0	84.2	15.8
LT 12	35.1	64.9	52.0	48.0	64.9	35.1

[a]Completed or currently enrolled in doctoral program.

[b]Includes master's degree students.

[c]Graduate students, current and prospective.

SOURCE: MARC Honors Survey.

Program Components

An important feature of the MARC Honors Undergraduate Research Training Program is the flexibility individual grant applicants have in designing their training programs. Variation in institutional resources and student academic preparation has led to a diversity of programs. Although research exposure is a key feature at all training sites, some features of the MARC Honors program vary from school to school.

In a short battery of questions (Questions 15 through 19, 25 and 26), survey respondents were asked if particular activities were part of their undergraduate science program and, if so, how these activities compared to other parts of their science curriculum. Almost all respondents reported having a close working relationship with a faculty member, working on a research project with a faculty member, and attending professional meetings (Table 5.12). Approximately three-fourths of the former trainees reported that they presented their own research, attended a series of lectures by outside scientists, or took special classes for MARC Honors students. Working on an extramural research project was the least frequently reported program experience. Just over 60 percent of the respondents indicated that they had been part of a summer research project at another institution.[6]

Although it was the least frequently reported experience, extramural research is the most highly praised component of the program.[7] Almost 60 percent of those with extramural research exposure rated it "much more beneficial" than other aspects of their undergraduate science program. The only other curriculum components approaching this level of appreciation were also related to "hands on" research experience. Nearly half of the respondents rated on-campus research projects and close working relationships with faculty members as "much more beneficial" than other aspects of their undergraduate science program.

Professional meetings and presentation of one's own research were valued less than the more laboratory-oriented aspects of the MARC experience. Less than 40 percent of the respondents rated meetings and presentations "much more valuable."

Special MARC Honors classes and guest lecturers had a less noticeable impact on the students, perhaps because they were less dramatic departures from the normal undergraduate educational experience. Fewer than one-third of the respondents rated special MARC Honors classes and guest lecturers "much more beneficial."

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[6]The site visits to MARC Honors program institutions revealed a difference of opinion at more research-oriented schools over the relative benefits of on-campus and off-campus summer research (Chapter 4).

[7]See also the respondents' comments in the following section.

TABLE 5.12 Participation and Evaluation of Components of Science Curriculum

Component	Percent "Yes"	Percent "Much More Beneficial"
Mentor (Q15) As part of your undergraduate science program, were you able to establish a close working relationship or a close intellectual relationship with a faculty member?	92.3	49.8
Research Project (Q16) As part of your undergraduate science program, were you involved in an on-campus research project with a faculty member?	89.7	47.0
Extramural Project (Q17) As part of your undergraduate science program, were you involved in a summer research project in industry or at an institution other than the university at which you were a student?	61.1	58.6
Professional Meetings (Q18) As part of your undergraduate science program, did you attend any scientific meetings or conferences?	93.5	36.3
Present Own Research (Q19) As an undergraduate, did you ever make a presentation of the findings of your own original research to a group of students or scientists?	79.6	39.3
MARC Courses (Q25) As part of your undergraduate MARC program, did you take special classes for MARC students?	75.0	31.4
Guest Lecturers (Q26) As part of your undergraduate MARC program, was there a special lecture series where scientists from other institutions were brought to your campus?	77.9	27.2

SOURCE: MARC Honors Survey.

Comments from Respondents

A surprisingly large percentage of the respondents wrote comments on the last page of the questionnaire. Excluding explanations or clarifications of specific survey items, over one-fourth (25.7 percent) of the returned questionnaires had substantive comments.

Respondents were provided space for "any additional comments on the survey questions, survey topics, or on your undergraduate science training." The MARC Honors program was not mentioned, yet nearly two-thirds (62.4 percent) of the comments referred specifically to the MARC program.[8] The MARC comments can be grouped into five categories:

-- MARC enhanced education (general);
-- MARC enhanced science education;
-- Appreciated research exposure of MARC;
-- MARC influenced their research career; and
-- Specific recommendations and criticisms of MARC.

Nineteen respondents noted that the MARC Honors program had enhanced their education (Table 5.13). In the words of one student, "If it had not been for the MARC program, I honestly feel that my overall educational background would not have come up to par." In addition to the skills they learned, respondents credited the MARC Honors program with building self-confidence, fostering independence, stimulating intellectual curiosity, and developing communication skills.

Another 19 respondents reported that the MARC Honors program enhanced their science education. In the words of one former trainee:

> Through the MARC undergraduate program I was able to better understand the complex nature of much that I had been taught previously in science classes, and learned to approach future material in a more analytical manner. It was in the program that I learned the crucial skills of scientific presentation, investigation, as well as the method used to locate materials in the journals.

> As I progressed through my final two undergraduate years, I found that the experience I had gained through MARC helped me through material which seemed to snare my classmates; I had an "edge" on classmates who were not a part of the program.

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[8]There were 128 respondents who wrote comments but several commented on more than one issue. There were 157 separate comments coded.

Another trainee expressed a similar appreciation of MARC:

> The MARC and MBRS programs were instrumental in forming my abilities, giving me a competitive edge in terms of skills and background for graduate school. In fact, the MARC and MBRS experience which I had was by far more valuable to me in teaching me science than most courses in the sciences.

TABLE 5.13 Comments From Respondents

Comments	Number	Percent
Comments Referring to MARC		
MARC enhanced education (general)	19	12.1
MARC enhanced science education	26	16.6
Appreciate research exposure of MARC	16	10.2
MARC influenced research career	21	13.4
Specific MARC recommendations and criticisms	16	10.2
Comments Not Referring to MARC		
Clarification of current career status	14	8.9
General comments about undergraduate education	23	14.6
Requests for job or fellowship information	5	3.2
Disappointments with		
Career progress	3	1.9
Job opportunities for bachelor's degree holders	9	5.7
Science, graduate school, scientists	5	3.2
Total[a]	157	100.0

[a]There were 128 respondents who wrote comments. Several made multiple comments. Therefore, the number of comments (157) exceeds the number of respondents.

SOURCE: MARC Honors Survey.

Although some students described MARC as an enhancement to their studies, others noted that MARC was an essential link to the mainstream of science. One woman made this point very emphatically in her comments:

> I was dissatisfied with my undergraduate science program primarily because my undergraduate institution did not have adequate funding to expose the science students to the latest advancements in their respective fields nor the latest technologies. Our books and equipment were outdated and we were not able to subscribe to any scientific journals. Being in the MARC program helped me make my decision to remain in the sciences because I was given the opportunity to go to another institution during the summer and, subsequently, be exposed to the techniques, journals, etc. that are necessary ingredients in becoming a competent, respected research scientist.

One feature of the MARC Honors program--exposure to research--was repeatedly singled out in the respondents' comments. Sixteen people acknowledged their appreciation of the research exposure they gained through the MARC Honors program. Several students reported that, had it not been for the MARC Honors program, they would not have had an opportunity for research training. The research experiences of the MARC Honors program were not a normal part of the undergraduate curriculum, as the comments of one student indicated:

> The program afforded me the opportunity to gain valuable research and work experience even before completion of undergraduate school.... The program exposed those students interested in pursuing scientific research to various aspects of graduate studies. Participants were also able to become familiar with advanced scientific instruments while in the program.

Twenty-one students reported that the MARC Honors experience had a major impact on their decisions to pursue research careers. Several mentioned that their plans to go to medical school changed as a result of their exposure to research in MARC Honors programs. In the words of one student:

> I would like to emphasize that the major impetus to my pursuing a Ph.D. was the opportunity to conduct original research through the MBRS and MARC programs. Had it not been for the presence of these programs at my undergraduate institution, I would probably have just gone to medical school and not been a scientist at all.

Others emphasized how MARC Honors experiences enhanced their ability to pursue research careers by preparing them for the challenges of graduate school.

> The MARC program was invaluable to me in its introduction to career science. I am presently a Ph.D. candidate at MIT and feel that the experience with the program has made my stay in graduate school easier. I'll not soon forget the time and care faculty took with me, and a NIH summer internship was probably the single most important preparation for grad school.

Another student credits the MARC Honors program with important insights that rescued his scientific career.

> I feel the MARC and MBRS programs were crucial in my decision to try for a career in science. Without that experience, I would have never considered science as a possible career option. By working in a lab as an undergraduate, I had a good idea of what I wanted in a lab as a graduate student. It gave me the confidence to change from one graduate program to another when the first one was not what I expected.

Most of the comments on the MARC Honors program were favorable. Several respondents, however, took the time to make specific recommendations or criticisms of the MARC Honors program. Of the 16 respondents making specific suggestions, half mentioned the need for more academic guidance and career counseling.

Several comments did not refer to the MARC Honors program. Most of these comments were explanations or clarifications of current career statuses (14) or general comments about educational experiences (23). A sizable group (17) mentioned disappointments of one sort or another. Three people mentioned disappointments with career progress. The focus in these cases was on personal achievement. A larger group (9) reported disappointment with the job opportunities for persons with bachelor's degrees in science. It should be recalled that 8 other respondents criticized the MARC Honors program for failing to provide sufficient academic guidance and career counseling. A common experience may underlie both concerns. Finally, a small number of respondents (5) expressed dissatisfaction with "the narrowness of science," prejudice in the academic community, and maltreatment of graduate students. Although these disappointments should not be dismissed, they represent only a small fraction (13.3 percent) of the persons volunteering comments.

Conclusion

The overwhelming majority of former trainees (76.1 percent) go on to graduate or professional school. A large number pursue professional doctorates, but a substantial percentage seek research doctorates. Many students are in master's degree programs and may continue on into doctorate level work. Attrition from graduate or professional programs does not seem to be a problem. Nearly one-half of those who leave a graduate or professional program return to school.

Although exact comparisons cannot be made, the rates of graduate school attendance and employment in science for the MARC trainees are above those found in the most closely comparable national data. Unemployment rates among former trainees are low, not much different from the national average for recent science graduates.

A sizable portion of the former trainees (35.7 percent) expect to be in research careers at age 35. A slightly larger group (42.6 percent) plan clinical careers. Science-related jobs in a nonclinical, nonresearch setting is the goal of 15.3 percent of the MARC Honors alumni. (These jobs are largely in computer science and engineering.) Only 7.4 percent expect to be working outside of science or engineering.

The former trainees report high levels of satisfaction with all parts of the MARC Honors experience. The extramural research project is the least frequently experienced MARC Honors activity, but it is the most highly praised by those who participated in it. Other research-related experiences (on-campus research with a faculty member and a close intellectual relationship with a faculty member) were also highly valued by the former trainees.

6. BACHELOR'S DEGREES AWARDED IN THE BIOLOGICAL SCIENCES: PROGRAM AND NONPROGRAM SCHOOLS

The percentages of bachelor's degrees earned in the biological sciences at program and nonprogram schools were examined over time to assess the institutional impact of the MARC Honors and MBRS programs. At program schools, the percentage of biological science majors increased--especially among minority students. National trends showed no such increase for minority students and decreasing percentages for nonminority students. The higher rates at the MARC and MBRS schools remained when other institutional characteristics were taken into consideration.

Two programs funded by the National Institutes of Health seek to increase the involvement of minority undergraduate students in biomedical research: the Minority Biomedical Research Support (MBRS) program initiated in 1972 and the Minority Access to Research Careers (MARC) Honors Undergraduate program initiated in 1977. Both provide financial support for minority undergraduate students, and both involve them directly in research projects. Undergraduate students participate in MBRS as employees on faculty research projects and are paid on an hourly basis. The MARC Honors Undergraduate Research Training program is smaller and more selective than MBRS. MARC Honors undergraduate trainees must be honor students with grade point averages of 3.0 or better. They receive stipends and participate in a specially designed curricula and research training activities. The expectation is that this exposure will increase the students' awareness of research careers and will enhance their ability to pursue these careers. Data presented in the preceding two chapters suggest that this expectation is realized in the case of the MARC Honors program.

In addition to enhancing the research awareness and the research skills of the funded students, both programs have broader, institutional goals. One objective of the MARC Honors program is to improve undergraduate science curricula; the MBRS program seeks to strengthen the schools' biomedical research capability. These qualitative, institutional objectives are more difficult to assess than individual achievements.

Some insight into these institutional objectives may be obtained indirectly. Improved curricula and strengthened research capabilities might increase student interest in the biomedical sciences. An expanded level of laboratory research may result in a more dynamic science environment and also heighten students' enthusiasm for science. This interest and enthusiasm might be reflected by an increase in biological science majors. In this chapter, changes over time in the rate at which students earn bachelor's degrees in the biological sciences are examined. Institutions with and without MARC Honors and MBRS programs are compared in an examination of the programs' institutional impacts.

Data

The basic data on bachelor's degrees come from the Survey of Degrees and Other Formal Awards Conferred conducted by the Department of Education. This survey is part of the Higher Education General Information Survey (HEGIS). Data on race are available only since 1976. However, for 1974, comparable data are available from a sample survey sponsored by the Higher Education Panel (HEP) of the American Council on Education.[1]

Degrees Conferred in the Biological Sciences

The percentage of bachelor's degrees awarded to students majoring in the biological sciences rose in the early 1970s and declined in the late 1970s. In 1973, 4.6 percent of the bachelor's degrees earned were in the biological sciences. This percentage rose to 5.4 in 1974 and rose again to 5.8 in 1976 (Figure 6.1). The percentage remained at 5.8 in 1977 and began to drop in 1979. By 1981, 4.7 percent of all bachelor's degrees were awarded to students majoring in the biological sciences.

Almost all of the decline was due to shifts among nonHispanic white students.[2] In 1976, 6 percent of all the bachelor's degrees earned by whites were in the biological sciences (Table 6.1). The level declined in all subsequent survey years, reaching 4.7 percent in 1981. There has been no such decline for the minority groups. For blacks and Hispanics, the percentage of bachelor's degrees earned in biology in 1971 was similar to the 1976 level. In 1974, 3.7 percent of all bachelor's degrees earned by blacks were in the biological sciences. The fraction rose slightly in 1976 and 1977, remained stable in 1979, and then dropped back near to its original level in 1981. There was a similar curvilinear pattern among Hispanics from 1976 to 1981.

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[1]The characteristics of the HEP survey and its correspondence to the HEGIS data are outlined in the following publication: Frank J. Atelsek and Irene L. Gomberg. Bachelor's Degrees Awarded to Minority Students 1973-74.

[2]This group will be referred to as "white students."

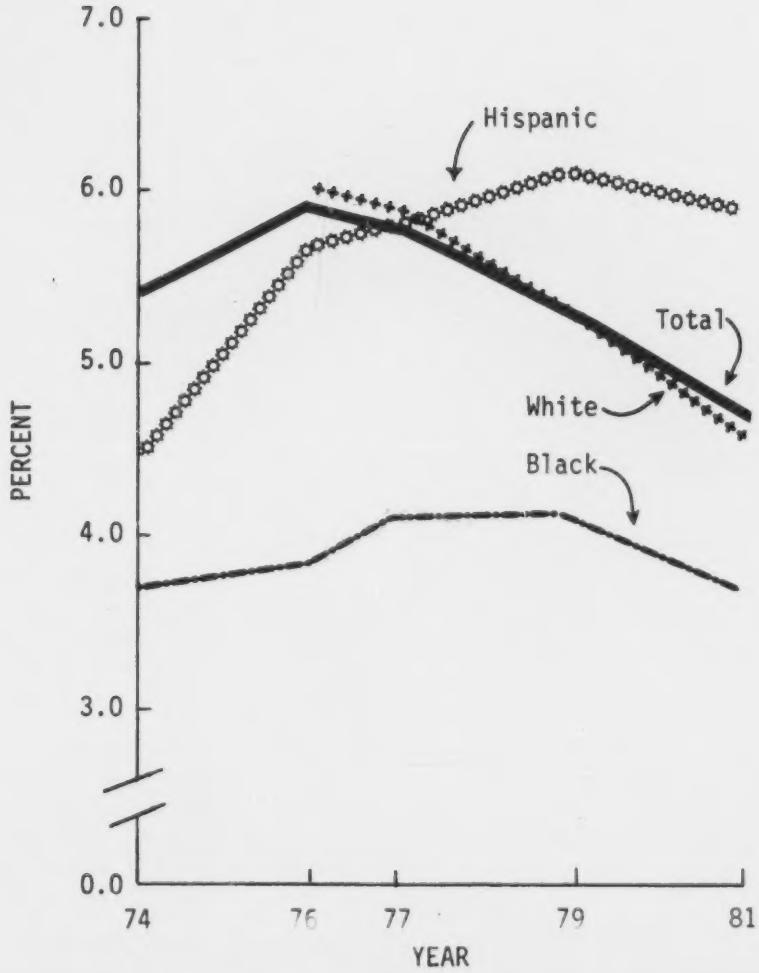

FIGURE 6.1 Percentage of all bachelor's degrees that were awarded in the biological sciences, by race, 1974-81. See Table 6.1 for supporting data.

TABLE 6.1 Percentage of All Bachelor's Degrees That Were Awarded in the Biological Sciences, by Institution Type and Race of Graduate, 1973-1981[a]

Institution Type/ Race of Graduate	Year					
	1973	1974	1976	1977	1979	1981
Total						
Black		3.7	3.8	4.1	4.1	3.7
Hispanic		4.4	5.7	5.8	6.1	5.9
White[b]			6.0	5.9	5.3	4.6
Total[c]	4.6	5.4	5.9	5.8	5.3	4.7
Predominantly Black Institution						
Black		4.5	4.3	4.8	5.2	4.5
Hispanic			4.4	3.5	9.5	4.7
White[b]			4.0	2.3	2.8	3.0
Total[c]		4.3	4.4	4.9	5.3	4.5
Predominantly White Institution						
Black		3.1	3.6	3.7	3.6	3.3
Hispanic			5.7	5.8	6.1	5.9
White[b]			6.0	5.9	5.3	4.6
Total[c]		5.4	5.9	5.9	5.3	4.7
MARC Honors						
Black			4.1	4.9	5.1	4.8
Hispanic			7.2	6.4	8.2	8.4
White[b]			6.7	6.8	6.4	5.8
Total[c]			5.8	6.0	6.2	5.7
MBRS						
Black			3.9	4.4	5.0	4.5
Hispanic			6.9	6.5	7.9	7.4
White[b]			5.8	6.1	5.8	5.2
Total[c]			5.3	5.5	5.9	5.3

[a]Data in 1974 are from HEP sample survey; all other data are population totals from HEGIS.

[b]This category excludes all those of Hispanic ethnicity.

[c]Totals include smaller ethnic groups not shown separately.

SOURCES: Atelsek and Gomberg, 1977; U.S. Department of Education, HEGIS Survey of Degrees and Other Formal Awards Conferred.

The rate at which students majored in the biological sciences varied substantially by type of institution. Black students attending predominantly black institutions were more likely to be biological science majors than were black students attending other types of institutions.[3] Similar findings are reported by Atelsek and Gomberg (1977) in their study of bachelor's degrees awarded in the 1973-74 school year. White students were more likely to be biology majors in predominantly white institutions and less likely to be biology majors in predominantly black institutions. Hispanics were also less likely to be biology majors in predominantly black schools. This suggests that a group's numerical dominance in an institution was related to its likelihood of majoring in the biological sciences. Blacks and whites were more likely to be biology majors when they were numerically predominant in a school.

MARC Honors and MBRS Schools

The MARC Honors and MBRS programs were designed for institutions that have enrollments drawn substantially from minority populations. As a result, there is an overlap between predominantly black schools, MARC Honors schools, and MBRS schools. A listing of schools with MBRS or MARC Honors programs operating in 1981[4] is presented in Appendix F.

For blacks, there was a net gain in the percentage of biology majors at MARC Honors and MBRS schools in the 1976 to 1981 period. This was in contrast to the percentages for all black students (in all schools) which showed no net change from 1976 to 1981. Nationwide, 3.8 percent of all bachelor's degrees earned by blacks in 1976 were in the biological sciences (Table 6.1). At MBRS schools the rate was the same; at MARC Honors program schools it was just slightly higher. During the next few years, the proportion of biology degrees earned by blacks rose dramatically in MARC Honors and MBRS institutions. In 1981, there was a decline in biology majors at all types of schools. However, among black students in MARC Honors and MBRS institutions, the gains of the late 1970s were not erased. At MARC Honors schools, 4.8 percent of the degrees earned by blacks in 1981 were in the biological sciences. At MBRS schools, the percentage was 4.4. In both cases, the rate exceeded the national average for all black graduates (3.7 percent).

The rate at which Hispanic students majored in biology at MBRS and MARC Honors schools also exceeded the national average for Hispanics. The percentage of Hispanic biology majors increased from 1976 to 1981 at program and nonprogram schools, but the increase was larger at program schools. In MARC Honors schools, the percentage of Hispanics

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[3]See Appendix E for list of predominantly black institutions.
[4]Since 1981 is the most recent year of degree data, schools joining MARC and MBRS after 1980 are not counted as program participants in this portion of the study.

earning degrees in biology rose from 7.2 percent in 1976 to 8.4 percent in 1981. In MBRS schools, 6.9 percent of the Hispanic degrees in 1976 went to biology majors. In 1981, this percentage rose to 7.4. The national average for Hispanics during this same period rose from 5.7 to 5.9 percent.

Program Cohorts

Gradual implementation and expansion have been important characteristics of the MARC and MBRS programs. The earliest MARC Honors programs were funded in 1977 and the first MARC Honors trainees graduated in the spring of 1978. Presentations combining data for all program schools for the 1976 to 1981 period run the risk of confounding preprogram and postprogram effects. A more rigorous test of program impact requires the examination of schools grouped by year of initial funding.

Table 6.2 presents this data for MBRS schools. The data cover the crucial period of MBRS growth, 1972 through 1975. Program growth slowed after 1975. The few schools that received their initial MBRS funding after 1975 tended to be institutions with small enrollments, and there were insufficient cases to support analyses for these schools.

The largest and most consistent gains were found among the black graduates. In the MBRS institutions first funded in 1972 and 1973, the percentages of black biology majors rose and then fell, following the general pattern observed for blacks in all U.S. schools. Among the 1974 and 1975 schools, the increase continued uninterrupted (with the exception of one year, 1977, for the 1975 grantees). From 1976 to 1981, all groups of MBRS schools had net increases in the proportion of black students majoring in the biological sciences. This is in contrast to national averages for black students which fell from 3.8 percent in 1976 to 3.7 percent in 1981.

Hispanic students show a much more varied pattern when observed by program cohorts. In the institutions first funded in 1972, the proportion of Hispanics majoring in the biological sciences dropped steadily from 1976 to 1981. The opposite pattern occurred among the 1973 grantees. Among the 1974 and the 1975 grantees, the percentage of Hispanics majoring in the biological sciences rose and then declined. Hispanics showed smaller and less consistent gains at MBRS schools than did blacks. However, Hispanics at MBRS schools were more likely than blacks to major in biology.

Perhaps the most striking feature of the Hispanic data was the extremely high percentage of 1981 biology graduates in the 1973 grantee institutions--over 10 percent. The 1973 schools included the University of Albuquerque and the University of Puerto Rico, two schools that draw students from large "established" Hispanic communities. Consistent with the earlier observations about blacks and whites, Hispanics are more likely to be biology majors in schools where they are numerically predominant.

TABLE 6.2 Percentage of All Bachelor's Degrees That Were Awarded in the Biological Sciences at MBRS Schools, by Year of Initial Grant to Institution and Race/Ethnicity of Graduate

Year of Initial Grant to Institution/Race of Graduate	Year of Degree			
	1976	1977	1979	1981
1972				
Black	4.2	4.9	5.3	4.8
Hispanic	7.9	6.6	6.7	5.7
White[a]	5.9	4.6	4.0	3.2
Total[b]	5.0	5.4	5.5	4.7
1973				
Black	3.3	4.2	5.5	3.7
Hispanic	7.2	6.7	9.6	10.1
White[a]	3.6	4.8	4.7	4.9
Total[b]	4.9	5.3	6.7	6.3
1974				
Black	4.6	5.0	5.1	5.2
Hispanic	7.9	9.5	8.9	6.9
White[a]	3.9	4.8	3.7	3.1
Total[b]	5.4	5.3	5.1	4.4
1975				
Black	3.0	0.8	4.4	5.2
Hispanic	5.0	4.8	6.3	5.1
White[a]	10.3	10.7	9.6	8.6
Total[b]	8.7	9.0	9.0	7.9

[a]This category excludes all those of Hispanic ethnicity.

[b]Totals include smaller ethnic groups not shown separately.

SOURCE: U.S. Department of Education, HEGIS Survey of Degrees and Other Formal Awards Conferred.

For the MARC Honors program schools, grouping institutions by year of first funding did not eliminate the gains reported in Table 6.1. In each of the first three cohorts there were increases in the percentage of black biology majors subsequent to the initiation of the MARC Honors program (Table 6.3). Among the 1977 grant recipients, the rising percentage of black biology majors from 1977 to 1979 occurred following the establishment of the MARC Honors program. An even larger growth in the percentage of black biology majors was found in the 1978 cohort of institutions. Some of this 1977 to 1979 change may have been due to the impact of the MARC Honors program. The 1979 grant recipient schools had an increase in black biology majors during the 1979 to 1981 period.

The increases in the percentage of Hispanics majoring in the biological sciences also remained when the schools were grouped by year of initial MARC Honors funding. For the 1977 schools, increases in the percentage of Hispanics earning biology degrees in 1979 could have been partly due to program effects. The same holds for 1978 grant recipients in 1979 and 1981. There were no Hispanic students in the 1979 grantee institutions. The 1980 grantees had a very large number of Hispanic students. New MARC Honors grants were awarded to 13 schools in 1980 including several schools with large or predominant Hispanic populations (Catholic University of Puerto Rico, University of Puerto Rico-Rio Piedras, and University of Texas, San Antonio). In this group of schools, the extremely high proportion of biology majors among Hispanics is consistent with the previously observed positive correlation between ethnic representation and earned degrees in the biological sciences. The impact of the MARC Honors program could have been partially responsible for the increase in the proportion of Hispanic biology majors in these schools between 1979 and 1981.

In summary, the data from the MARC Honors program schools suggest the possibility of positive program impact on the percentage of earned degrees in the biological sciences. During the period that the MARC programs were in operation, the percentage of students majoring in the biological sciences increased at MARC Honors schools for both blacks and Hispanics. The gains were smaller than those found for the MBRS program, but these differences between program effects are entirely consistent with the longer history, broader mission, and greater size of MBRS.

Alternative Hypotheses

The data in the preceding section indicate that the percentage of black students earning bachelor's degrees in the biological sciences increased at MBRS schools and that the percentage of black and Hispanic students earning biology degrees increased at MARC Honors program schools. These findings are consistent and suggest the operation of direct program effects. However, other causes could be responsible for the observed associations.

In 1976, before the MARC Honors program began, schools that would later receive MARC Honors grants were above the national average in their percentage of black, Hispanic, and white students earning degrees

TABLE 6.3 Percentage of All Bachelor's Degrees in the Biological Sciences at MARC Honors Program Schools, by Year of Initial Grant to Institution and Race/Ethnicity of Graduates

Year of Initial Grant to Institution/Race of Graduate	Year of Degree			
	1976	1977	1979	1981
1977				
Black	4.5	6.0	6.5	6.5
Hispanic	2.9	2.7	4.2	3.3
White[a]	4.6	4.5	4.4	3.9
Total[b]	5.2	4.6	4.2	4.3
1978				
Black	5.0	6.2	7.9	7.9
Hispanic	2.0	3.2	4.8	5.3
White[a]	4.0	5.2	5.6	5.5
Total[b]	3.9	4.6	5.3	5.0
1979				
Black	3.2	2.5	2.3	3.7
Hispanic	-	-	-	-
White[a]	-	1.6	1.7	1.7
Total[b]	3.2	2.5	2.1	3.5
1980				
Black	4.6	5.6	5.8	5.7
Hispanic	8.2	7.3	8.9	10.0
White[a]	6.9	7.3	7.3	7.2
Total[b]	6.6	6.9	7.5	7.6

[a]This category excludes all those of Hispanic ethnicity.

[b]Totals include smaller ethnic groups not shown separately.

SOURCE: U.S. Department of Education, HEGIS Survey of Degrees and Other Formal Awards Conferred.

in biology (Table 6.1). Comparing MARC Honors institutions, data in Table 6.3 indicate that schools first funded in 1977 had higher percentages earning degrees in biology in 1976 than did schools receiving initial funding in 1978 or 1979.

In addition to different "starting points", other factors could underlie the relationship between MARC Honors programs and biology majors. Earlier in this chapter it was shown that schools' racial characteristics were related to the rate at which blacks, whites, and Hispanics earned degrees in biology. Astin (1978) found that students attending private colleges were more likely to major in the sciences than students at public colleges. Other school characteristics, e.g., the level of science funding and the presence of a doctoral program on campus, may also be related to the rate at which students earn degrees in biology.

Additional Data

To better specify the relationship between school characteristics and program outcomes, additional data were obtained. Measures of federal support for science were taken from the 1980 Survey of Federal Support to Universities, Colleges, and Selected Nonprofit Institutions conducted by the National Science Foundation (NSF). From several highly correlated items a single measure, the amount of life sciences training support money from all agencies, was selected. It had the highest correlation with proportion of students majoring in biology ($r = .09$ for 1980 funding and 1981 graduates). Information on highest degree awarded and type of control (public/private) were also taken from the NSF data file.

Institutions that did not award bachelor's degrees in biology were eliminated from the data file. Six schools were also excluded because all of their graduates received degrees in biological sciences. These schools (optometry, podiatry, and chiropractic colleges) were highly specialized institutions and unsuited for comparison with the remaining undergraduate institutions.

Further adjustments were necessary for the analysis of racial and ethnic groups. In order to focus on institutional impacts of the MARC and MBRS programs, schools rather than individuals became the unit of analysis. For each school, the percentages of black, Hispanic, and white graduates earning degrees in the biological sciences were calculated by dividing the number of biology graduates from each racial or ethnic group by the total number of graduates from that race or ethnic group. Minority group members are concentrated at a small number of schools, and many institutions have very few minority group members. A change of 1 biology major in a school with 5 black graduates results in a shift of 20 percentage points. To avoid unrealistic and artificially inflated indicators, only schools with 30 or more graduates from a given race or ethnic group in 1976 and 1981 were used in this portion of the analysis.

This restriction excludes a different number of schools for each ethnic group. For blacks, the number of schools was reduced from 1,793 in the original data set to 330 (Table 6.4). Although they were a small percentage of the total number of schools (18.4 percent), they included over three-fourths of the black students. For Hispanics, the loss of

TABLE 6.4 Comparison of Graduation Data from All Undergraduate Institutions and Undergraduate Institutions with 30 or More Graduates from a Given Race/Ethnic Group

Race/Ethnicity	Number of Schools	Number of 1976 Graduates	Number of 1981 Graduates	Percent Biological Sci. (1976)	Percent Biological Sci. (1981)
Black					
All Schools	1,793	58,385	60,726	3.8	3.7
Schools with 30 or more Black Graduates	330	47,157	46,120	3.9	3.9
Hispanic					
All Schools	1,793	26,117	33,135	5.7	5.9
Schools with 30 or more Hispanic Graduates	117	20,446	23,341	6.0	1.7
White					
All Schools	1,793	806,108	807,347	6.0	4.6
Schools with 30 or more White Graduates	1,147	765,537	757,144	6.2	4.8

SOURCE: U.S. Department of Education, HEGIS Survey of Degrees and Other Formal Awards Conferred.

schools was greater than for blacks. Only 117 schools (6 percent) had 30 or more Hispanic graduates. These schools contained 70 percent of the Hispanic graduates. A few schools were eliminated because they had less than 30 white students. The 1,147 schools with 30 or more white graduates contained over 94 percent of the white graduates in 1976 and 1981.

Regression Models

In the regression models the percentage of 1981 graduates earning degrees in the biological sciences was viewed as a function of the 1976 percentage and the number of years of MARC Honors or MBRS program funding prior to 1981. Regressing the 1981 percentage on the 1976 percentage and the MARC Honors or MBRS indicators (MARC-YRS or MBRS-YRS) revealed the impact of a year of program funding on the 1981 percentages after the 1976 level was controlled.[5]

The results for the MARC Honors program are summarized in Model 1 of Table 6.5.[6] The percentage of black graduates earning degrees in the biological sciences rose by nearly one percentage point for each year that the institution was in the MARC Honors program. The effect was somewhat smaller for Hispanics. White students at MARC Honors program schools were also more likely to major in the biological sciences than white students at nonMARC schools. The increment was small (.25 for each year of MARC funding), but in the same direction as that for the black and Hispanic students. These gains suggest an institutional impact of the MARC Honors program.

In schools with MBRS programs there was also a rise in the percentage of biological science majors (Model 2, Table 6.5). Each year of MBRS funding raised the level of black biology majors by .17 percentage points. For Hispanics and whites, there was no measured effect of the MBRS programs on the percentage of bachelor's degrees earned in the biological sciences.[7]

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[5]The models can be expressed in the following form:

$$PCTBIO81 = a + b_1 (PCTBIO76) + b_2 (MARC\text{-}YRS) \text{ and}$$

$$PCTBIO81 = a + b_1 (PCTBIO76) + b_2 (MBRS\text{-}YRS).$$

[6]Tests of statistical significance are not discussed because the regression coefficients are population parameters and not sample estimates.

[7]There are substantive as well as statistical reasons why it would be a mistake to use these findings to contrast the effectiveness of the two programs. Almost all MARC Honors programs are at institutions with MBRS programs, and interviews with MARC Honors program directors repeatedly emphasize how MARC Honors programs are built upon MBRS resources. (See Chapter 4 for a discussion of the program interrelationship.) The MBRS programs are, on the average, older than the MARC Honors programs, and the years of observation (1976 and 1981) represent different points in the life cycle of the two programs.

TABLE 6.5 Regression Equations Measuring the Impact of MARC Honors and MBRS Programs on the Percentage of Bachelor's Degrees Earned in the Biological Sciences in 1981

Model	Regression Weights[a] Black	Hispanic	White
MODEL 1:			
Intercept	1.537	1.017	1.094
	(.258)	(.541)	(.148)
PCTBIO76[b]	.540	.833	.659
	(.044)	(.070)	(.018)
MARC-YRS	.943	.440	.247
	(.208)	(.545)	(.332)
R^2	.349	.552	.531
N	329	116	1,146
MODEL 2:			
Intercept	1.488	1.159	1.104
	(.270)	(.541)	(.148)
PCTBIO76[b]	.539	.833	.659
	(.045)	(.071)	(.018)
MBRS-YRS	.174	-.066	-.022
	(.057)	(.137)	(.081)
R^2	.327	.551	.531
N	329	116	1,146
MODEL 3:			
Intercept	.759	.556	-.484
	(.443)	(.851)	(.682)
PCTBIO76[b]	.466	.712	.649
	(.047)	(.073)	(.019)
MARC-YRS	.736	.564	.461
	(.221)	(.522)	(.334)
DEGTOT8	.0001	-.0001	-.0003
	(.0002)	(.0003)	(.0001
ALLBIOT81	.0007	.0009	.0001
	(.0002)	(.0003)	(.0002
DOC80	.309	1.697	-.147
	(.449)	(.857)	(.270)
PRIVAT80	.487	.056	.226
	(.439)	(.871)	(.204)
RELSIZE[b]	.018	.016	.019
	(.006)	(.013)	(.007)
R^2	.392	.617	.541
N	329	116	1,146

[a]Standard errors are in parentheses.
[b]For each race or ethnic group (black, Hispanic and white), the corresponding percentage was used.

SOURCES: U.S. Department of Education, HEGIS Survey of Degrees, Other Formal Awards Conferred; National Science Foundation, Survey of Federal Support to Universities, Colleges, and Selected Nonprofit Institutions.

The benefits attributed to MARC Honors programs by Model 1 may be due to other factors. In Model 3, the regression equation used in Model 1 was expanded to include the following indicators as predictors of the percentage of graduates earning degrees in the biological sciences: total number of degrees granted in 1981 (DEGTOT81); federal biological sciences training funds in 1980 (ALLBIOT8); the existence of doctoral programs in 1980 (DOC80); and private control (PRIVAT80).

A measure of each race or ethnic group's relative size in the student population (RELSIZE) was also included. Adding these institutional characteristics to the regression model did little to alter the conclusions about the impact of the MARC Honors program. Each year of MARC Honors funding was associated with a rise of .74 percentage points in the rate at which black students earn biology degrees. Only a small amount of the effect of the MARC Honors program found in Model 1 was mediated by the other school characteristics. The results for Hispanics were quite similar to those for blacks. Every additional year of MARC Honors funding raised the level of Hispanic degrees in the biological sciences by just over one-half a percentage point. Among whites, the effect of the MARC Honors program was smaller than for blacks or Hispanics. Still, every additional year of MARC Honors funding raised the level of white degrees earned in the biological sciences by nearly one-half a percentage point.

A final test of the impact of the MARC Honors program was made by examining the relationship between program size and the percentage of degrees earned in the biological sciences. If there is a direct impact of the programs (rather than a spurious association due to some other institutional characteristic), then the size of the MARC Honors program should have a positive relationship with its impact on campus. A regression equation replacing the number of years of MARC funding (MARC-YRS) with the number of MARC Honors trainees graduating in 1981 (MARC81G) is presented in Table 6.6 (Model 1). Because only schools with MARC Honors programs were examined, the number of cases dropped dramatically.

The size of the MARC Honors program was clearly related to the percentage of bachelor's degrees earned in the biological sciences. Every additional MARC Honors trainee graduating in 1981 was associated with an increase of one-half point in the percentage of blacks earning bachelor's degrees in the biological sciences.[8] The increase for Hispanics was much greater (2.6 percentage points) while the increase for whites was less (under .2 of a percentage point per graduate).

The positive relationship between MARC Honors program size and the rate at which students major in the biological sciences did not disappear when other school characteristics were added to the

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[8]The relationship may strike the reader as tautological. However, since MARC Honors students are recruited as junior or senior level majors in the biological sciences, the program does not have to increase the number of majors.

TABLE 6.6 Regression Equations Measuring the Impact of MARC Honors Program Size on the Percentage of Bachelor's Degrees Earned in the Biological Sciences in 1981

	Regression Weights[a]		
Model	Black	Hispanic	White
MODEL 1:			
Intercept	1.102	-7.136	1.230
	(1.835)	(2.221)	(2.751)
PCTB1076[b]	.883	1.331	.669
	(.295)	(.196)	(.324)
MARC81G	.548	2.641	.175
	(.455)	(.562)	(.743)
R^2	.326	.912	.485
N	28	7	8
MODEL 2:			
Intercept	-.025		
	(6.126)		
PCTB1076[b]	.809		
	(.367)		
MARC81G	.925		
	(.517)		
DEGTOT81	-.0001		
	(.003)		
ALLBIOT8	-.020		
	(.024)		
DOC80	16.171		
	(10.564)		
PRIVAT80	.840		
	(2.355)		
RELSIZE[b]	.016		
	(.56)		
R^2	.476		
N	28		

[a]Standard errors are in parentheses.

[b]For each race or ethnic group (black, Hispanic, and white), the corresponding percentage was used.

SOURCES: U.S. Department of Education, HEGIS Survey of Degrees, Other Formal Awards Conferred; National Science Foundation, Survey of Federal Support to Universities, Colleges, and Selected Nonprofit Institutions.

regression equations (Table 6.6, Model 2[9]). When the effects of school size, biological science training funds, doctoral programs, private control, and percentage black were controlled, an increase of one MARC Honors trainee was associated with nearly a one point increase in the percentage of students earning degrees in the biological sciences.

Summary

Nationwide, the percentage of white students earning degrees in the biological sciences has decreased, while the percentage of minority group members earning degrees in the biological sciences has remained at the same level. The percentage of biological science majors has increased among minority students at MARC Honors and MBRS institutions. Both the length and size of the programs were associated with higher rates of degrees earned in the biological sciences. These gains were broad, often extending beyond the minority students who were the targets of the programs. These differences between program and nonprogram schools remained even after the impact of other institutional characteristics was taken into consideration.

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[9]Because of the small number of MARC Honors schools with 30 or more Hispanic or white graduates in both 1976 and 1981, this equation was not calculated for Hispanics or whites.

REFERENCES

Ashe, Warren. 1978. "Statement to the Committee on National Needs for Biomedical and Behavioral Research Personnel, February 9, 1978." Summarized in Public Hearing Testimony Concerning Minorities, 1978 and 1979, by Richard Albert. Unpublished staff paper. Washington, D.C.: National Academy of Sciences.

Astin, Alexander W. 1982. Minorities in American Higher Education. San Francisco: Jossey-Bass.

Astin, Alexander W. 1978. Four Critical Years. San Francisco: Jossey-Bass.

Atelsek, Frank J. and Irene L. Gomberg. 1977. Bachelor's Degrees Awarded to Minority Students, 1973-74. Higher Education Panel Reports Number 24. Washington, D.C.: American Council on Education.

Berryman, Sue. 1983. Who Will Do Science? Minority and Female Attainment of Science Degrees: Trends and Causes. New York: Rockefeller Foundation.

Blackwell, James E. 1981. Mainstreaming Outsiders: The Production of Black Professionals. Bayside, N.Y.: General Hall.

Green, Rayna D. 1976. The Barriers Obstructing the Entry of Native Americans into the Natural Sciences. A report by the Project on Native Americans in Science, Office of Opportunities in Science. Washington, D.C.: American Association for the Advancement of Science.

Gilford, Dorothy M. and Joan Snyder. 1977. Women and Minority Ph.D.s in the 1970's: A Data Book. Washington, D.C.: National Academy of Sciences.

Hamilton, Franklin D. 1977. "Undergraduate Research Training." In Vijaya L. Melnick and Franklin D. Hamilton (eds.), pp. 225-230. Minorities in Science: The Challenge for Change in Biomedicine. New York: Plenum.

Jay, James M. 1977. "Black Americans in the Sciences." In Vijaya L. Melnick and Franklin D. Hamilton (eds.), pp. 3-8. Minorities in Science: The Challenge for Change in Biomedicine. New York: Plenum.

Malcom, Shirley M., Michele Aldrich, Paula Q. Hall, Patricia Boulware, and Virginia Stern. 1984. "Equity and Excellence: An Assessment of Programs that Facilitate Increased Access and Achievement of Females and Minorities in K-12 Mathematics and Science Education. Washington, D.C.: American Association for the Advancement of Science.

Malcom, Shirley M., John Cownie, and Janet W. Brown. 1976. Programs in Science for Minority Students, 1960-1975. Washington, D.C.: American Association for the Advancement of Science.

Malcom, Shirley M., Paula Q. Hall, and J. W. Brown. 1976. The Double Bind: The Price of Being a Minority Woman in Science. Washington, D.C.: American Association for the Advancement of Science.

Melnick, Vijaya L. 1977. "Public Policy for Minority Self-Actualization: Present Realities and Future Possibilities." In Vijaya L. Melnick and Franklin D. Hamilton (eds.), pp. 83-91. Minorities in Science: The Challenge for Change in Biomedicine. New York: Plenum.

Murphy, Lucy P. and E. Wesley McNair. 1981. "A Long-Range Evaluation of a Biomedical Science Program for Undergraduate Minority Students." Journal of Medical Education, vol. 56, no. 3, pp. 196-197.

National Advisory Committee on Black Higher Education and Black Colleges and Universities. 1979. Access of Black Americans to Higher Education: How Open is the Door?. Washington, D.C.: U.S. Government Printing Office.

National Center for Educational Statistics. U.S. Department of Health, Education, and Welfare. 1976. Earned Degrees Conferred 1972-73 and 1973-74, Summary Data. NCES 76-105. Washington, D.C.: U.S. Government Printing Office.

National Research Council. 1973-82. Survey of Earned Doctorates. A computerized data file. Washington, D.C.

National Research Council. 1983. Summary Report. Doctorate Recipients from United States Universities. Washington, D.C.: National Academy of Sciences.

National Science Foundation. 1982. Characteristics of Recent Science and Engineering Graduates: 1980. Washington, D.C.: U.S. Government Printing Office.

National Science Foundation. 1984a. Characteristics of Recent Science and Engineering Graduates: 1982. Washington, D.C.: U.S. Government Printing Office.

National Science Foundation. 1984b. Women and Minorities in Science and Engineering. Washington, D.C.: U.S. Government Printing Office.

Thomas, Gail E. 1984. "Determinants and Motivations Underlying the College Major Choice of Race and Sex Groups." Center for the Social Organization of Schools. Baltimore: John Hopkins University.

Tristan, Michael P., Valory N. Pavlik, Billy S. Rankin, Jerry Lester, and Carlos Vallbona. 1981. "Review of a Program for Premedical Minority Students." Texas Medicine, vol. 77, March, pp. 51-54.

U.S. Department of Education. National Center for Educational Statistics. 1976-1981. Degrees and Other Formal Awards Conferred. A computerized data file. Washington, D.C.

U.S. Department of Education. National Center for Educational Statistics. 1976, 1978, and 1980. Fall Enrollment in Colleges and Universities. Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Health, Education, and Welfare. Public Health Service. National Institutes of Health. (No date.) MARC: A Guide to Undergraduate Research Training.

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APPENDIX A MARC Program Institutions, by Year First Funded and Number of Trainees Graduating or Terminating

MARC Institution	Year First Funded	Academic Year of Graduation or Termination							
		1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	Total
Medgar Evers College	1977	0	5	6	3	5	2	5	26
Benedict College	1977	4	1	3	2	2	3	0	15
Tougaloo College	1977	0	2	2	3	4	4	1	16
Johnson C. Smith University	1977	3	3	4	4	4	2	4	24
Texas Southern University	1977	2	6	3	7	3	5	4	30
Talladega College	1977	7	5	4	5	7	5	5	38
University of New Mexico	1977	3	6	6	5	6	3	1	30
Clark College*	1977	2	1	3	1	3	1	3	14
Morehouse College*	1977	0	2	1	2	2	4	4	15
Morris Brown College*	1977	1	1	3	2	2	2	0	11
Spelman College*	1977	1	1	3	2	1	3	4	15
New Mexico State University	1977	4	2	6	1	2	2	4	21
Jackson State University	1977	6	3	7	1	10	2	9	38
Northeast Oklahoma State University	1977	1	2	4	2	3	0	3	15
Prairie View A&M	1977	2	2	6	4	5	5	7	31
City College of New York	1978	-	6	6	3	4	4	2	25
California State Univ., Los Angeles	1978	-	2	4	4	4	3	3	20
Fisk University	1978	-	2	6	6	8	6	6	34
Univerity of Minnesota, Duluth	1978	-	0	1	7	1	4	3	16
University of Hawaii, Manoa	1978	-	3	8	6	9	6	1	33
Savannah State College	1979	-	-	3	1	6	4	6	20
North Carolina A&T	1979	-	-	3	3	5	4	4	19
Xavier University	1979	-	-	3	2	4	1	5	15
Miles College	1979	-	-	0	1	2	0	1	4
Bishop College	1979	-	-	0	4	1	0	1	6
Tennessee State University	1980	-	-	-	2	2	7	8	19
North Carolina Central University	1980	-	-	-	3	2	6	4	15
Univ. of the District of Columbia	1980	-	-	-	2	4	2	2	10
Virginia State University	1980	-	-	-	2	5	4	7	18
Tuskeegee Institute	1980	-	-	-	0	3	3	2	8
University of Texas, San Antonio	1980	-	-	-	1	4	5	4	14
Bethune-Cookman College	1980	-	-	-	1	3	2	5	11
Catholic University, Puerto Rico	1980	-	-	-	1	4	6	5	16
Howard University	1980	-	-	1	1	9	3	11	25
South Carolina State University	1980	-	-	-	2	1	2	2	7
University of Puerto Rico, Rio Piedras	1980	-	-	-	5	7	7	9	28
Hunter College	1980	-	-	-	3	6	2	2	13
University of California, Santa Cruz	1980	-	-	-	3	2	6	4	15

*Funded jointly under a grant to the Atlanta University Center, Inc.

APPENDIX A MARC Program Institutions (Continued)

MARC Institution	Year First Funded	Academic Year of Graduation or Termination							
		1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	Total
Fort Lewis College	1981	-	-	-	-	1	2	0	3
Norfolk State University	1981	-	-	-	-	4	6	6	16
Long Island University	1981	-	-	-	-	2	2	4	8
California St. Univ.-Dominguez Hills**	1981	-	-	-	-	1	2	0	3
Loyola Marymount University**	1981	-	-	-	-	0	3	2	5
Dillard University	1981	-	-	-	-	0	3	2	5
Alabama A&M	1982	-	-	-	-	-	0	2	2
Morgan State University	1982	-	-	-	-	-	1	5	6
Central State University	1982	-	-	-	-	-	1	4	5
Wayne State University	1982	-	-	-	-	-	0	5	5
University of California, San Diego	1983	-	-	-	-	-	-	-	-
Lincoln University	1983	-	-	-	-	-	-	-	-
Hampton Institute	1983	-	-	-	-	-	-	-	-
University of Alaska, Anchorage	1983	-	-	-	-	-	-	-	-
Southern University, Baton Rouge	1983	-	-	-	-	-	-	-	-
St. Mary's University	1983	-	-	-	-	-	-	-	-
Barry University	1983	-	-	-	-	-	-	-	-
California State Univ., Long Beach	1983	-	-	-	-	-	-	-	-
Total All Institutions		36	55	97	106	163	146	182	785

**Funded under a single grant to Charles R. Drew.

SOURCE: MARC Grant Renewal Applications.

NATIONAL ACADEMY OF SCIENCES
2101 CONSTITUTION AVENUE
WASHINGTON, D. C. 20418

INSTITUTE OF MEDICINE

COMMITTEE ON NATIONAL NEEDS FOR
BIOMEDICAL AND BEHAVIORAL RESEARCH PERSONNEL

(202) 334-3186

APPENDIX B:
Letter to Program Directors

Dear Dr. _____:

The National Academy of Sciences has been asked by the National Institutes of Health to conduct an evaluation of the MARC Honors Undergraduate Research Training Program. As Elward Bynum noted in his letter of April 17, we will be sending questionnaires to former MARC trainees as a part of our evaluation. In order to gather information that is unobtainable through surveys of former trainees, we also plan to visit several MARC institutions. Your school is one that we have selected to visit. There are two general topics which we wish to pursue:

-- What has been the impact of the MARC program on students and faculty members at your institution?
-- How has the science curriculum (both MARC and nonMARC) evolved over the life of the program?

To minimize the disruption to your work, I was hoping to complete all of my work on your campus in a single day. (If you have any descriptive information about your program that you would be willing to share with us, I would be happy to review it prior to my visit.) I would prefer to begin my visit by speaking with you. Later I would like to speak with MARC trainees and, if possible, some potential candidates for MARC traineeships. Finally, I would also like to talk with several other faculty members involved in (or knowledgeable of) the MARC program. Our task is not to judge individual programs, but to evaluate the overall success of the MARC program in meeting its stated objectives. As a general guide, I have enclosed a list of topics that I would like to discuss with the students and faculty members.

I was hoping to visit your campus during the week of October 1, 1984. After you have had a chance to think about this request and discuss it with the relevant parties, I would be grateful if you could contact me at the Academy so that we could arrange the most convenient schedule. My telephone number is (202) 334-3186. If you or anyone connected with your program have any questions regarding the nature or purpose of my visit, please let me know. I look forward to meeting with you.

Sincerely yours,

Howard H. Garrison

Howard H. Garrison, Ph.D.
Project Director

Enclosure

Discussion Topics for MARC Visits

Issues for students

- Career goals
- Program activities
- Effect on GPA
- Source of information
- Role in research
- Interaction w/Principal Investigator

Issues for faculty members

- Recruitment of students to MARC
- Selection of students
- Levels of faculty participation
- Institutional infrastructure and support
- Relationship of MARC to other programs (e.g., MBRS)
- Curriculum innovation
- Impact of MARC on nontrainees majoring in the sciences

Statistical data comparing trainees to nontrainees

- Courses taken
- Grade point average

APPENDIX C

Cover Letters and Questionnaire--
Survey of Undergraduate Science Majors

NATIONAL ACADEMY OF SCIENCES
2101 CONSTITUTION AVENUE
WASHINGTON, D. C. 20418

INSTITUTE OF MEDICINE

COMMITTEE ON NATIONAL NEEDS FOR
BIOMEDICAL AND BEHAVIORAL RESEARCH PERSONNEL

(202) 334-3186

November 12, 1984

Dear Graduate:

The National Academy of Sciences, an independent, nonprofit organization, is conducting a study of undergraduate science majors. This is part of a larger study of the training of biomedical and behavioral scientists being done at the request of the U.S. Congress and the National Institutes of Health.

We need to learn about the education and work experiences of undergraduates who majored in science. You have been selected to be in our sample and we are asking you to help us by filling out the enclosed questionnaire and returning it to us in the postage-paid envelope. The information you give us will be used in formulating our recommendations on science programs. Please fill out the questionnaire even if you changed majors and had a nonscience major when you graduated. Although vital to our work, your participation is strictly voluntary.

The questionnaire should take no more than a few minutes to complete. The questions are straightforward and concern your educational experiences and work history. All of the information you provide will be treated as confidential and safeguarded in accordance with the Privacy Act of 1974. Your individual answers will not be presented in our report; only averages and other summary measures will be used. If you have any comments or wish to clarify an answer, please do so in the margin of the questionnaire. There is room at the end of the questionnaire for longer comments on the issues raised in the questionnaire or for remarks about your science training in general.

Thank you very much for your cooperation. Your participation will assist us in making our recommendations to Congress and the National Institutes of Health. If you have any questions about this survey, please call Dr. Howard Garrison (collect). His telephone number is (202) 334-3186.

Thank you again,

Robert L. Hill

Robert L. Hill, Ph.D.
Chairman, Committee on National
Needs for Biomedical and
Behavioral Research Personnel

Enc.

NATIONAL ACADEMY OF SCIENCES
2101 CONSTITUTION AVENUE
WASHINGTON, D. C. 20418

INSTITUTE OF MEDICINE

COMMITTEE ON NATIONAL NEEDS FOR
BIOMEDICAL AND BEHAVIORAL RESEARCH PERSONNEL

(202) 334-3186

January 8, 1985

Dear Graduate:

Several weeks ago we sent you a questionnaire as part of our study of undergraduate science majors. As of this date we have not received your completed questionnaire. Your answers are essential to us. Our goal is to provide Congress and the National Institutes of Health with accurate and representative information on the training and career progress of science students. In order to do this, we need information from everyone in our survey population.

We have enclosed a second copy of our questionnaire in the event that the first copy was lost or misplaced. Most of the questions require that you simply check a box; the entire questionnaire will probably take no more than a few minutes to complete. As I indicated in my earlier letter, your answers will be kept confidential. If you have any questions, call me collect at (202) 334-3186.

Please complete the questionnaire and return it in the enclosed envelope. If your answers are already in the mail, please accept our thanks and ignore the second questionnaire.

Sincerely yours,

Howard Garrison

Howard Garrison, Ph.D.
Project Director

OMB No. 0925-0237
Approval expires 12/86

National Academy of Sciences

Survey of Undergraduate Science Majors

If your name or address is incorrect, please enter correct information below.

As the accompanying letter explained, we are conducting a study of the educational and career experiences of students who were science majors as undergraduates. Your complete and candid answers to all survey questions will be greatly appreciated. Our report will contain only averages and other aggregate measures. A Degree and Employment Specialty List is provided at the end of the booklet to help you answer several questions. Please comment on any question that you feel requires fuller explanation in the space provided at the end of the questionnaire. Thank you for your cooperation.

1. When were you born?
   ____/____
   (month) (year)
2. Are you a U.S. citizen?
   1. ☐ no
   2. ☐ yes
3. What is your sex?
   1. ☐ Male
   2. ☐ Female
4. What is your racial background?
   1. ☐ American Indian or Alaskan Native
   2. ☐ Asian or Pacific Islander
   3. ☐ Black
   4. ☐ White
5. Is your ethnic heritage Hispanic?
   1. ☐ no
   2. ☐ yes

6. During the week of November 12, 1984 were you enrolled as a student?
   1. ☐ no. Please skip to Question 7.
   2. ☐ yes. Please continue

   6a. What type of program were you enrolled in? (check one)
   1. ☐ Nondegree
   2. ☐ Bachelor's degree
   3. ☐ Master's degree
   4. ☐ Research doctorate (Ph.D.)
   5. ☐ Clinical doctorate (M.D., O.D., D.D.S., D.V.M., etc.)
   6. ☐ Other professional degree (L.L.B., J.D., etc.)

   6b. From the Degree and Employment Specialty List on page 6, select and enter *both* the specialty name (major) and *number* most closely related to your educational program.
   ____/____
   (name of specialty) (number)

7. In the table below, list in chronological order all of the degrees that you have earned (beginning with your undergraduate degree). Please use the Degree and Employment Specialty List on page 6 for major field and number.

TYPE OF DEGREE	MO/YR GRANTED	SCHOOL NAME CITY (OR CAMPUS)	MAJOR FIELD NAME/NUMBER	

8. Did you ever attend a graduate school or professional school, but leave *before* finishing a degree?
   1. ☐ no (skip to Q. 9)
   2. ☐ yes

   8a. If *yes*, what type of program were you enrolled in? (check one)
   - 1. ☐ Nondegree
   - 2. ☐ Bachelor's degree
   - 3. ☐ Master's degree
   - 4. ☐ Research doctorate (Ph.D.)
   - 5. ☐ Clinical doctorate (M.D., O.D., D.D.S., D.V.M., etc.)
   - 6. ☐ Other professional degree (L.L.B., J.D., etc.)

   8b. Why did you leave?

   _____

   _____

   _____

   _____

   _____

   8c. Which of the following were major factors in your decision to leave the program? (check all that apply)
   - 1. ☐ Lack of interest in the program
   - 2. ☐ External factors such as marriage, children, etc.
   - 3. ☐ Educational expenses
   - 4. ☐ Lack of preparation for the program
   - 5. ☐ Expectations of future earnings

9. What was your employment status as of the week of November 12, 1964? Please answer even if you were a student.
   1. ☐ Postdoctoral appointment (fellowship, traineeship, research associateship, etc.) (Skip to Q. 12)
   2. ☐ Not employed

   9a. *If not employed*, were you seeking employment?
   - 1. ☐ no
   - 2. ☐ yes

   (Skip to Q. 12)
   3. ☐ Employed

   9b. *If employed*, was this full-time or part-time employment? (check one)
   - 1. ☐ Full-time (35 hours or more)
   - 2. ☐ Part-time (less than 35 hours)

10. Was this job you held during the week of November 12, 1964 a science or engineering related position?
   1. ☐ yes (Skip to Q. 11)
   2. ☐ no

   10a. *If no*, what was the most important reason for taking the position? (check one)
   - 1. ☐ Prefer nonscience or nonengineering
   - 2. ☐ Promoted out of science or engineering position
   - 3. ☐ Pay is better
   - 4. ☐ Locational preference
   - 5. ☐ Science or engineering position not available
   - 6. ☐ Other (please specify)

   _____

   _____

11. From the Degree and Employment Specialty List on page 6, select and enter both the name and number of the specialty most closely related to your principal employment during the week of November 12, 1964. Please write in your specialty even if it is not on the list.

   _____/_____

   (name of specialty) (number)

CAREER PLANS

12. What kind of work do you expect to be doing when you are 35 years old?

   _____

   (job name)

   From the Degree and Employment Specialty List on page 6, select and enter *both* the name and number of the specialty most closely related to this job. Please write in the specialty even if it is not on the list.

   _____/_____

   (name of specialty) (number)

   12a. Is this work a science-related occupation?
   - 1. ☐ no
   - 2. ☐ yes

13. Do you think you will need more education, training, or schooling than you have at present in order to obtain this kind of work or to advance as you would like in your job or career?
   - 1. ☐ no
   - 2. ☐ yes
   - 3. ☐ don't know

13a. *If yes*, what is the highest level of additional education you will need? (check one)

1. ☐ Nondegree program
2. ☐ Baccalaureate degree
3. ☐ Master's degree
4. ☐ Research doctorate (Ph.D.)
5. ☐ Clinical doctorate (M.D., O.D., D.D.S., D.V.M.)
6. ☐ Other professional degree (L.L.B., J.D., etc.)

UNDERGRADUATE SCIENCE EDUCATION

14. Overall, how satisfied were you with the *quality* of your undergraduate science program? (check one)

1. ☐ Very satisfied
2. ☐ Satisfied
3. ☐ Neither satisfied nor dissatisfied
4. ☐ Dissatisfied
5. ☐ Very dissatisfied

15. As part of your undergraduate science program, were you able to establish a close working relationship or a close intellectual relationship with a faculty member?

1. ☐ no
2. ☐ yes

15a. *If yes*, in comparison with other parts of your science curriculum, how beneficial to your science education was this relationship? (check one)

1. ☐ Much more beneficial
2. ☐ More beneficial
3. ☐ Neither more nor less beneficial
4. ☐ Less beneficial
5. ☐ Much less beneficial

16. As part of your undergraduate science program, were you involved in an on-campus research project with a faculty member?

1. ☐ no
2. ☐ yes

16a. *If yes*, in comparison with other parts of your science curriculum, how beneficial to your science education was this research project? (check one)

1. ☐ Much more beneficial
2. ☐ More beneficial
3. ☐ Neither more nor less beneficial
4. ☐ Less beneficial
5. ☐ Much less beneficial

17. As part of your undergraduate science program, were you involved in a summer research project in industry or at an institution other than the university at which you were a student?

1. ☐ no
2. ☐ yes

17a. *If yes*, in comparison with other parts of your science curriculum, how beneficial to your science education was this research project? (check one)

1. ☐ Much more beneficial
2. ☐ More beneficial
3. ☐ Neither more nor less beneficial
4. ☐ Less beneficial
5. ☐ Much less beneficial

18. As part of your undergraduate science program, did you attend any scientific meetings or conferences?

1. ☐ no
2. ☐ yes

18a. *If yes*, in comparison with other parts of your science curriculum, how beneficial to your science education were these conferences? (check one)

1. ☐ Much more beneficial
2. ☐ More beneficial
3. ☐ Neither more nor less beneficial
4. ☐ Less beneficial
5. ☐ Much less beneficial

19. As an undergraduate, did you ever make a presentation of the findings of your own, original research to a group of students or scientists?

1. ☐ no
2. ☐ yes

19a. *If yes*, in comparison with other parts of your science curriculum, how important to your *career plans* was this experience? (check one)

1. ☐ Much more important
2. ☐ More important
3. ☐ Neither more nor less important
4. ☐ Less important
5. ☐ Much less important

20. As an undergraduate, how much did you learn about research topics or research problems that were of immediate interest to the scientific community? (check one)

1. ☐ A lot
2. ☐ Some
3. ☐ Little
4. ☐ Nothing at all

21. As an undergraduate student, did you receive any career counseling or guidance from faculty members?

1. ☐ no
2. ☐ yes

22. As part of your undergraduate program, were you able to work with highly complex scientific instrumentation (i.e., instrumentation similar to that used by practicing scientists)?

1. ☐ no
2. ☐ yes

23. As an undergraduate student, did you receive guidance and counseling from faculty members in applying to graduate school?

1. ☐ no
2. ☐ yes

24. Were you ever a trainee or fellow in the Minority Access to Research Careers (MARC) Honors Undergraduate program? (check one)

1. ☐ no
2. ☐ not sure

} Please skip to Q. 27

3. ☐ yes. Please continue

24a. How many months did you spend on this program?

_____
(months)

24b. Did you receive your bachelor's degree while on the MARC program?

1. ☐ no
2. ☐ yes

25. As part of your undergraduate MARC program did you take special classes for MARC students?

1. ☐ no
2. ☐ yes

25a. *If yes,* in comparison with other parts of your science curriculum, how beneficial to your science education were these courses? (check one)

1. ☐ Much more beneficial
2. ☐ More beneficial
3. ☐ Neither more nor less beneficial
4. ☐ Less beneficial
5. ☐ Much less beneficial

26. As part of your undergraduate MARC program, was there a special lecture series where scientists from other institutions were brought to your campus?

1. ☐ no
2. ☐ yes

26a. *If yes,* in comparison with other parts of your science curriculum, how beneficial to your science education was this lecture series? (check one)

1. ☐ Much more beneficial
2. ☐ More beneficial
3. ☐ Neither more nor less beneficial
4. ☐ Less beneficial
5. ☐ Much less beneficial

27. As an undergraduate student, were you ever a part of the Minority Biomedical Support (MBS) or Minority Biomedical Research Support (MBRS) programs?

1. ☐ no
2. ☐ not sure

} Please skip to Q. 28

3. ☐ yes. Please continue.

27a. How many months did you spend on this program?

_____
(months)

27b. Did you receive your bachelor's degree while in the MBS or MBRS program?

1. ☐ no
2. ☐ yes

28. Estimate how well you did in all of your course work for your *UNDERGRADUATE* degree. (IF YOUR SCHOOL DID NOT GRADE ON A 4.0 BASIS, CONVERT YOUR RECORD TO THE APPROPRIATE CATEGORY.) CHECK ONE BOX ONLY.

1. ☐ Mostly A (3.75-4.00 Grade Point Average)
2. ☐ About half A and half B (3.25-3.74 Grade Point Average)
3. ☐ Mostly B (2.75-3.24 Grade Point Average)
4. ☐ About half B and half C (2.25-2.74 Grade Point Average)
5. ☐ Mostly C (1.75-2.24 Grade Point Average)
6. ☐ About half C and half D (1.25-1.74 Grade Point Average)
7. ☐ Mostly D or below (Less than 1.25 Grade Point Average)

Thank you for your help.

Please use the space below if you have any additional comments on the survey questions, survey topics or on your undergraduate science training:

Please return the completed form in the enclosed envelope to the National Academy of Sciences, JH 630, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

DEGREE AND EMPLOYMENT SPECIALTY LIST

Agriculture

013 Agronomy
014 Animal, dairy, poultry sciences
015 Farm and range management
016 Fish, game and wildlife management
017 Food sciences
018 Forestry and related sciences
019 Horticulture
020 Natural resources management
021 Soil science
090 Agricultural sciences, other

Biological Sciences

211 Anatomy, histology
213 Biochemistry
214 Biophysics
215 Botany
221 Cell and molecular biology
216 Entomology
226 Embryology
217 Genetics
218 Immunology
219 Marine biology
220 Microbiology, bacteriology
227 Neurosciences
222 Nutrition
228 Parasitology
223 Pathology, human, animal, plant
224 Physiology, human, animal, plant
229 Radiobiology
230 Toxicology
225 Zoology
290 Biological sciences, other

Education

413 Biological sciences education
414 Engineering education
417 Mathematics education
421 Physical sciences education
425 Social science education
490 Education, other

Engineering

511 Aerospace, aeronautical, astronautical
512 Agricultural
513 Architectural
514 Bioengineering and biomedical engineering
515 Chemical
516 Civil, construction, and transportation
518 Computer engineering
517 Electrical, electronic, and communication
529 Engineering science
519 Environmental and sanitary
520 Geological
521 Industrial
530 Materials
522 Mechanical
523 Metallurgical
524 Mining and mineral
525 Naval architecture and marine engineering
526 Nuclear
531 Ocean
527 Petroleum
751 Operations research/management sciences
590 Engineering, other

Mathematical Sciences

711 Actuarial science
723 Computer and information sciences
750 Mathematics
751 Operations research/management sciences
713 Statistics
780 Mathematical sciences, other

Physical Sciences

720 Astronomy
721 Atmospheric sciences and meteorology
213 Biochemistry
722 Chemistry
741 Earth sciences and geology
733 Metallurgy
742 Oceanography
731 Physics
790 Physical sciences, other

Social Sciences

811 Anthropology
812 Criminology
813 Economics
814 Geography
823 Linguistics
817 Political science and government
818 Psychology (except clinical)
821 Sociology
822 Urban studies
890 Social sciences, other

Health Sciences

511 Clinical psychology
512 Dentistry
514 Hospital and health care administration
515 Medicine or pre-medicine
516 Nursing
517 Pharmacology
518 Pharmacy
590 Health sciences, other

Arts and Humanities

109 Area and ethnic studies
110 Arts and letters, general
115 English and journalism
114 Fine and applied arts
116 Foreign language and literature, all fields
117 History
119 Philosophy
120 Religion and theology

Other Specialties

911 Architecture and environmental design
914 Business and commerce
912 Home economics, all fields
913 Law and prelaw
915 Military science, including merchant marine deck officer
916 Social work
999 Other fields

APPENDIX D

Comparison of Survey Respondents and Nonrespondents

TABLE D.1 Response Rates by Academic Year of Program Entry

		Response		
Academic Year		No	Yes	Total
1977-78	N	50	63	113
	%	44.2%	55.8%	100.0
1978-79	N	32	54	87
	%	37.2%	62.8%	100.0
1979-80	N	53	93	146
	%	36.3%	63.7%	100.0
1980-81	N	57	101	158
	%	36.1%	63.9%	100.0
1981-82	N	55	141	196
	%	28.1%	71.9%	100.0
1982-83	N	37	70	107
	%	34.6%	65.4%	100.0
1983-84	N	3	12	15
	%	20.0%	80.0%	100.0
TOTAL	N	287	534	821
	%	35.0%	65.0%	100.0

SOURCES: MARC Honors Survey and MARC Grant Renewal Applications.

TABLE D.2 Mean Grade Point Average of Respondents and Nonrespondents

	Response	
GPA	No	Yes
Mean	3.18	3.33
Standard Deviation	.52	.42
Number	138	309

SOURCE: MARC Grant Renewal Applications.

TABLE D.3 Average Number of Months in Program for Respondents and Nonrespondents

	Response	
Months in Program	No	Yes
Mean	15.0	16.5
Standard Deviation	7.7	6.7
Number	198	393

SOURCE: MARC Grant Renewal Applications.

TABLE D.4 Grade Point Averages: Program Directors' Reports by Survey Respondents' Reports

GPA Reported by:

	Survey Respondents					
Program Directors	A	A/B	B	B/C	C	Total
A	37	4				41
A/B	33	106	5			144
B	2	30	59	1	1	93
B/C		1	8	3		12
C or Lower			2	1	1	4
Total	72	141	74	5	2	294

[a]The data were originally reported to two decimal places on a four point scale. They were recoded to match the response categories presented to the survey population.

SOURCES: MARC Honors Survey and MARC Grant Renewal Applications.

APPENDIX E

Predominantly Black Institutions[1]

ALABAMA
- Alabama Agricultural and Mechanical University
- Alabama Lutheran Academy and College
- Alabama State University
- Lawson State Community College
- Miles College
- Oakwood College
- Selma University
- Stillman College
- Talladega College
- Tuskegee Institute

ARKANSAS
- Arkansas Baptist College
- Philander Smith College
- Shorter College
- University of Arkansas, Pine Bluff

CALIFORNIA
- Compton Community College

DELAWARE
- Delaware State College

DISTRICT OF COLUMBIA
- University of the District of Columbia
- Howard University

FLORIDA
- Bethune Cookman College
- Edward Waters College
- Florida Agricultural and Mechanical University
- Florida Memorial College

GEORGIA
- Albany State College
- Atlanta University
- Clark College
- Fort Valley State College
- Morehouse College
- Morris Brown College
- Paine College
- Savannah State College
- Spelman College

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[1]From NSF, Resources Supporting Scientific Activities at Predominantly Black Colleges and Universities. Washington, D.C.: National Science Foundation. 1982, pp. 6-7.

ILLINOIS
- Chicago State University

KENTUCKY
- Kentucky State College

LOUISIANA
- Dillard University
- Grambling State University
- Southern University and A&M College
- Xavier University of Louisiana

MARYLAND
- Bowie State College
- Coppin State College
- Morgan State University
- University of Maryland, Eastern Shore

MICHIGAN
- Highland Park Community College
- Shaw College at Detroit
- Wayne County Community College

MISSISSIPPI
- Alcorn State University
- Coahoma Junior College
- Jackson State University
- Mary Holmes College
- Mississippi Industrial College
- Mississippi Valley State University
- Prentiss Normal and Industrial Institute
- Rust College
- Tougaloo College

MISSOURI
- Harris-Stowe State College
- Lincoln University

NORTH CAROLINA
- Barber-Scotia College
- Bennett College
- Elizabeth City State College
- Fayetteville State University
- Johnson C. Smith University
- Livingstone College
- North Carolina A&T State University
- North Carolina Central University
- Shaw University
- St. Augustine's College
- Winston-Salem State University

OHIO
- Central State University
- Wilberforce University

OKLAHOMA
- Langston University

PENNSYLVANIA
- Cheyney State College
- Lincoln University

SOUTH CAROLINA
- Allen University
- Benedict College
- Claflin College
- Denmark Technical College
- Friendship College
- Morris College
- South Carolina State College
- Voorhees College

TENNESSEE
- Fisk University
- Knoxville College
- Lane College
- LeMoyne-Owen College
- Meharry Medical College
- Morristown College
- Tennessee State University

TEXAS
- Bishop College
- Huston-Tillotson College
- Jarvis Christian College
- Paul Quinn College
- Prairie View Agricultural & Mechanical University
- Southwestern Christian College
- Texas College
- Texas Southern University
- Wiley College

VIRGINIA
- Hampton Institute
- Norfolk State University
- St. Paul's College
- Virginia State University
- Virginia Union University

VIRGIN ISLANDS
- College of the Virgin Islands

APPENDIX F

1981 MBRS and MARC Institutions

INSTITUTION	CITY	MBRS	MARC
Alabama A & M Univ	Normal	X	
Miles College	Birmingham		X
Selma University	Selma	X	
Stillman College	Tuscaloosa	X	
Talladega College	Talladega	X	X
Tuskegee Institute	Tuskegee	X	X
California St. U., Dom. Hills[1]	Dominguez Hills	X	X
California St. U., Los Ang.	Los Angeles	X	X
Loyola Marymount[1]	Los Angeles		X
East Los Angeles College	Monterey Park	X	
San Jose St. University	San Jose	X	
Univ. of Calif., San Diego	San Diego	X	
Univ. of Calif., Santa Cruz	Santa Cruz	X	X
Fort Lewis College	Durango		X
Univ. of Southern Colorado	Pueblo	X	
Delaware State College	Dover	X	
Howard University	Washington, D.C.	X	X
Univ. District of Columbia	Washington, D.C.	X	X
Bethune-Cookman College	Daytona Beach	X	X
Florida A & M University	Tallahassee	X	
Albany State College	Albany	X	
Atlanta Univ. Center, Inc.[2]	Atlanta	X	X
Fort Valley State College	Fort Valley	X	
Savannah State College	Savannah	X	X
University of Hawaii - Hilo	Hilo	X	
University of Hawaii - Manoa	Honolulu	X	X
Chicago State University	Chicago	X	
Kentucky State University	Frankfort	X	
Dillard University	New Orleans	X	X
Grambling University	Grambling		
Southern University	Baton Rouge	X	
Xavier Univ. of Louisiana	New Orleans	X	X
Univ. of MD, Eastern Shore	Princess Anne	X	
Wayne State University	Detroit	X	
University of Minn/Duluth	Duluth		X
Alcorn State University	Lorman	X	
Jackson State University	Jackson	X	X
Tougaloo College	Tougaloo	X	X
Lincoln University	Jefferson City	X	

[1]Students attend MARC program sponsored by Charles R. Drew Postgraduate Medical School.
[2]MARC and MBRS programs involve students from four undergraduate schools: Clark, Morris Brown, Spelman, and Morehouse.

INSTITUTION	CITY	MBRS	MARC
College of Santa Fe	Santa Fe	X	
Navajo Comm. College-Shiprock	Shiprock	X	
New Mexico Highlands Univ.	Las Vegas	X	
New Mexico State University	Las Cruces	X	X
University of Albuquerque	Albuquerque	X	
University of New Mexico	Albuquerque	X	X
Bronx Community College	Bronx	X	
City College of the City University of New York	New York	X	X
Hunter College	New York	X	X
Long Island University	Brooklyn		X
Medgar Evers College	Brooklyn	X	X
State Univ. of New York/ College at Old Westbury	Old Westbury	X	
York College of the City University of New York	Jamaica	X	
Johnson C. Smith University	Charlotte	X	X
North Carolina A & T State U.	Greensboro	X	X
North Carolina Central Univ.	Durham	X	X
Winston-Salem State Univ.	Winston-Salem	X	
Central State University	Wilberforce	X	
Northeastern Oklahoma St. U.	Tahlequah	X	X
Southeastern Oklahoma St. U.	Durant	X	
Catholic Univ. - Puerto Rico	Ponce	X	X
Inter-American University, Metropolitan Campus	Hato Rey	X	
U. of Puerto Rico-Mayaguez	Mayaguez	X	
U. of Puerto Rico-Rio Piedras	Rio Piedras	X	X
Benedict College	Columbia	X	X
South Carolina State College	Orangeburg	X	X
Voorhees College	Denmark	X	
Fisk University	Nashville	X	X
LeMoyne-Owen College	Memphis	X	
Meharry Medical College	Nashville	X	
Meharry Medical College School of Medicine	Nashville	X	
Tennessee State University	Nashville	X	X
Bishop College	Dallas	X	X
Incarnate Word College	San Antonio	X	
Pan American University	Edinburg	X	
Prairie View A & M University	Prairie View	X	X
Texas A & I University	Kingsville	X	
Texas Southern University	Houston	X	X
University of Texas-El Paso	El Paso	X	
Univ. of Texas-San Antonio	San Antonio	X	X
Norfolk State University	Norfolk	X	X
Virginia State University	Petersburg	X	X

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